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IN TREATISES BY VARIOUS AUTHORS

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Corrections in Vol. II.

Page 7, *line* 3 *from* top, *for* $\frac{1}{50}$ *read* $\frac{20}{50}$.

,, 10. ,, 3 *from* bottom, *for* Plate I., Fig. 1, Plate III., Fig. 1, *read* Plate I., Figs. 1 and 2.

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DISEASES OF THE EYE.

CHAPTER I.

OPTICAL DEFECTS.

Refraction and Accommodation.—Emmetropia; Ametropia (Myopia, Hypermetropia, Presbyopia, Astigmatism).

ASSUMING the reader to be acquainted with the general laws of optics, it will be convenient to begin with their application to the eye as an optical instrument, and then to pass to the consideration of those defects which interfere with its proper performance.

The eye may be compared to a camera obscura in which the sclerotic, lined by the choroid, represents the box with its blackened interior; the iris corresponds to the perforated diaphragm which stops out the extreme peripheral rays of the incident cone of light; the ocular media answer to the system of lenses which collects the rays, and the retina to the screen upon which are formed the images of external objects lying before the camera.

Refraction.—The transparent media of the eye are the cornea, aqueous humour, lens, and vitreous humour. At each of their limiting surfaces all rays of light entering the eye (except such as coincide in direction with the optic axis) are refracted or bent from their previous direction, the chief refractions occurring at the anterior surface of the cornea, and the anterior and posterior surfaces of the lens. The purpose of these refractions is the collection of the rays in exact foci upon the retina, which is necessary for the production upon this membrane of a sharp image of an external object before the eye, an essential condition of distinct vision.

Refraction is a purely physical phenomenon; it might equally occur in a dead eye, whilst its media still preserved their true forms and their structural integrity. By *refraction*, or *refraction of the eye*, is to be understood the sum of all the refractions at the several limiting surfaces of the ocular media, the eye being at rest. In the normally constructed eye, at rest, the posterior principal focus (or meeting point of parallel rays) is on the bacillary layer of the retina. For our purpose we may conceive as parallel all rays incident upon the eye from objects distant twenty feet or more from the eye, since such distances are so very great relatively to the smallness of the pupillary opening, that rays entering this from luminous points at such distances include so minute an angle that they do not sensibly diverge. Luminous points situated at such distances as twenty feet or more are, therefore, conventionally conceived as infinitely distant.

For the normally constructed eye, the posterior principal focus being on the bacillary layer of the retina, the furthest point of distinct sight, *punctum remotissimum*, r is situated at infinite distance. Such an eye is termed by Professor Donders *Emmetropic* (ἔμμετρος, modum tenens, and ὤψ, oculus) and its refractive condition is *Emmetropia*.

Deviations from Emmetropia, comprised under the term Ametropia, occur in two opposite directions. In one of these the posterior principal focus of the eye is in front of the retina, the effect of which is to restrict r to a finite distance, whence sensibly divergent rays fall upon the eye. An eye thus conditioned could analogously be

termed *Brachymetropic*, *r* being at some shorter distance in front of it than infinite, and the condition would be called *Brachymetropia*, familiarly known as *Myopia*.

In the other deviation from Emmetropia the posterior principal focus is behind the retina. The refraction of such an eye, at rest, is insufficient to collect parallel rays in exact foci upon the retina, and rays incident upon the eye in order to be collected in exact retinal foci must already converge before entering the eye. Here *r* is conceived to lie beyond the measure of infinite distance, and the condition was termed by Professor Donders Hyperemmetropia, in its contracted form *Hypermetropia*.

The position of the posterior principal focus in Emmetropia, and in the two forms of Ametropia, Myopia, and Hypermetropia, is shown in Figs. 1–3.

Fig. 1.—Emmetropic eye in a state of rest. Parallel rays, *a*, *a*, come to a focus on the retina at *b*. Rays from a near object, *c*, being divergent, tend towards a focus behind the retina, *d*. The act of accommodation, which consists in increased convexity of the lens, causes these divergent rays to converge to a focus at *b*.

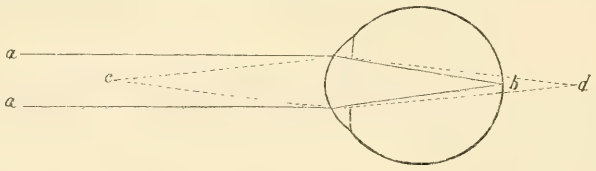


Fig. 2.—Myopic eye; too long in its antero-posterior diameter. Parallel rays, before reaching the retina, come to a focus at *b*; then, crossing, they form on the retina circles of dispersion at *b'*, *b'*.

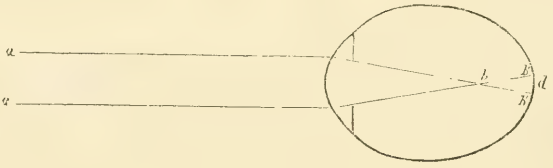
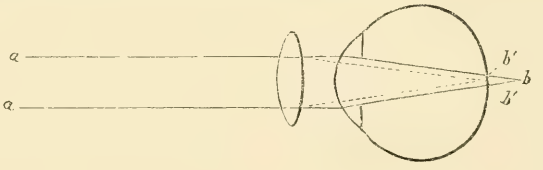


Fig. 3.—Hypermetropic eye; too short in its antero-posterior diameter. Parallel rays, tending towards a focus at *b*, form on the retina circles of dispersion at *b'*, *b'*. Divergent rays would tend towards a focus still more distant than *b*.



We have hitherto supposed the refraction of the eye to be equal in every meridian. This is not absolutely true; usually the refraction in the vertical meridian is stronger than that in the horizontal, owing to the radius of curvature of the cornea, in the former meridian being somewhat shorter. In Emmetropia this difference of refraction is so small that pencils of rays incident in these opposite meridians meet, if not with absolute exactitude, yet so very nearly at the same distance behind the common nodal point of the eye that the sharpness of the retinal image does not sensibly suffer. When, however, the refraction in any meridian differs by more than a minute quantity from that in the other meridians, the rays incident on that meridian do not meet in the same focal plane as those incident in other meridians, and the condition known as *Astigmatism* results. The difference of refraction may be one of excess or deficiency, so causing myopic and hypermetropic astigmatism. These may occur alone, refraction in other meridians being emmetropic; or in combination with

general myopia or hypermetropia, occasioning *compound astigmatism*; or, which is less frequent, both forms of astigmatism may be present, one meridian of the eye being myopic, and the opposite one hypermetropic, constituting *mixed astigmatism*.

Accommodation.—It has been mentioned that rays incident from a luminous point situated at a finite distance are divergent. It is evident that the refraction proper to unite in exact retinal foci rays incident on the eye from infinitely distant objects will not suffice to collect in exact foci on the retina divergent rays incident on the eye from nearer objects lying at finite distances.

To effect this the refraction of the eye must be changed; it must be increased proportionately to the greater divergence of the incident rays; in other words, to the nearness of the object desired to be seen distinctly. This change of the refraction of the eye for viewing nearer objects is termed *Accommodation*, less usually *Adaptation*, *Adjustment*.

It is a voluntary act, its mechanism being chiefly increased convexity of the anterior surface of the lens effected through the agency of the ciliary muscle.[1]

For every eye there is a distance within which an object cannot be distinctly seen even with the utmost tension of accommodation, because the rays falling upon the eye from a luminous point within this distance diverge too strongly to be collected in exact foci upon the retina. A point placed at the shortest distance at which it can be distinctly seen is termed the nearest point, *punctum proximum*, p, of distinct vision. The amount of accommodative change of refraction which is possible between complete relaxation and the greatest tension of accommodation is called the *range* of accommodation. It is expressed by the power of a convex lens which imparts to the rays falling on the eye from p the direction of those incident upon it from r; and this lens is given by the formula $\frac{1}{p}-\frac{1}{r}=\frac{1}{a}$, in which p is the measured distance of the nearest point of distinct vision from the common nodal point of the eye, r the furthest point, and a, the focal length of a convex lens conceived as superposed on that of the eye.

In early childhood p is very close to the eye; in the 12th year of life it is $2\frac{1}{2}$ inches distant; by the 25th year this distance has increased to 4 inches; at 40 it has become 8 inches; at 60 it exceeds 24 inches; in very advanced life it coincides with r, and may even be conceived as lying beyond infinite distance, the posterior principal focus of the eye in this case falling behind the retina.

When p has receded from the eye beyond 8 inches, it is found that occupation upon small and near objects, as needlework or books, especially by artificial light, becomes difficult, and the eye is then considered to be *Presbyopic*. It is evident that, with the recession of p from the eye, the range of accommodation (A) diminishes throughout life from childhood to old age. If numerical values are substituted for p, r, and a, then in the 12th year $\frac{1}{2\frac{3}{4}}-\frac{1}{0}=\frac{1}{2\frac{3}{4}}=$A, which is the range of accommodation. In other words, the change of accommodation which at this age the emmetropic eye effects in passing from complete relaxation to the greatest tension is equivalent to an increase of refraction, such as would be made by the addition to the eye of a convex lens of $2\frac{3}{4}$ inches focal length. At the 25th year a loss of A has been sustained equal to the difference between $\frac{1}{2\frac{3}{4}}$ and $\frac{1}{4}$; by the 40th year A has diminished to half of what it was in the 25th year; and when in old age p coincides with r, A wholly disappears.

The space between p and r is the region of accommodation. This is not to be confounded with range of accommodation, recently defined. The same range of accommodation may be found with very different regions of accommodation; thus with $p=8$ inches, and $r=\frac{1}{0}$; p at 4 inches, and r at 8 inches; p at 6 inches, and r

[1] For a full explanation of this the reader should consult any of the current text-books of physiology.

at 24 inches the range of accommodation, $A=\frac{1}{8}$, whilst the region of accommodation is in the first instance between 8 inches and infinity; in the second between 4 and 8 inches; and in the third example between 6 and 24 inches.

Hitherto accommodation has been considered with respect to one eye. When both are used it will be found that the proximate point of distinct sight p' is nearer than when one eye only was employed, for the intimate association of convergence of the visual axes with accommodation makes a higher tension of this possible when the eyes are strongly converged. There exists, therefore, a binocular proximate point of distinct vision p', which is distinct from the monocular p. Further, whilst the distance of the object, and therefore the convergence of the eyes, continues unaltered, the object can still be distinctly seen when collecting and dispersing lenses of a certain power are placed before the eyes. As the effect of such lenses is to lessen and to increase the divergence of the rays incident from the object upon the eye, their addition is equivalent to the approach and the withdrawal of the object, and involves relaxation and increased tension of accommodation. Besides the monocular and binocular proximate points of distinct vision, p and p', there is, therefore, for each degree of convergence of the eyes a relative proximate and remote point, p'' and r'' and range of accommodation.

The position of the proximate point of distinct vision p is easily ascertained with the wire optometer, which bears Von Gräfe's name, a small oblong metal frame across the opening of which are stretched several fine wires. It is moved from the greatest distance at which the wires are apparent gradually towards the patient, who is directed to endeavour to keep them distinctly in view, and to mention instantly where the slightest indistinctness occurs. This point is p, its distance from the eye is measured with a tape attached to the frame, or with a rule upon which the optometer is made to slide. This form of optometer gives satisfactory results with intelligent persons used to observe; but for the examination of the less intelligent, who not infrequently consider that they see the wires distinctly so long as they can count them, a single wire will be found a better test than a series of several wires. For artisans a thin edge, and for literary persons small print, are convenient tests.

For the determination of r, and also for testing the acuteness of sight (V), the scale of types devised by Snellen is largely used. For illiterate persons a scale of dots, such as those in Burckhardt's 'Internationale Sehproben,' may be substituted, but the results will scarcely be as accurate. The principle underlying Snellen's scale is that the letters are seen under an angle of 5° at the distance marked beneath them. If No. 20 in this scale is sharply seen at the distance of 20 feet, and the addition to the eye of a weak convex lens dims the test, r is conceived to be at infinite distance, the eye is emmetropic. If for the sharp definition of the test a concave lens of 20 inches focal length is required, r lies 20 inches before the eye, increased by the distance between its common nodal point and the lens. Again, if the test is sharply seen when a convex lens is placed before the eye, r is conceived as beyond infinite distance; it is a virtual point behind the eye towards which the rays incident from the test converge, and its distance from the common nodal point of the eye is given by the focal length of the strongest convex lens with which the test-object is distinctly defined, diminished by the interval between the lens and the ocular nodal point. Such determinations, however, have only an approximate value, since not infrequently in myopia, and generally in hypermetropia, the accommodation is not completely relaxed. When exactitude is desired, the ciliary muscle should be previously paralysed with atropine.

Trial Lenses and Spectacles.—For testing the refraction of the eye, and for selecting spectacles for treatment, trial lenses are indispensable. These are supplied by opticians in boxes containing sets of convex and concave lenses of spherical and of cylindrical curvatures, prisms, coloured glasses, diaphragms with narrow openings, stops, and one or more clip-frames in which the lenses and other apparatus can be placed for use.

Until very lately in this country, spectacle lenses were by most opticians and by practitioners in eye-diseases numbered according to their focal length expressed in inches, and the reciprocal of this expressed their power, which is inversely as the focal length. Thus Nos. 1, 2, 3, 4, &c. indicated a lens of 1, 2, 3, 4, &c. inches focal length, the dioptric power of which was as $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, &c.

Recently the French metre, called a *Dioptrie*, has been adopted by many practitioners abroad and by some at home as a basis of numeration. In this system the lenses are numbered according to their dioptric power, expressed in terms of the *dioptrie* D; thus a lens of 1 D, 2 D, 3 D, 4 D, &c. indicates a lens whose dioptric power is the sum of that of 1, 2, 3, 4 lenses, each of a power of a lens of 1 D. Facility of calculation in decimals, and the advantage of a universal basis of numeration, appear to be the chief recommendations of the system. In our article we shall still follow the old plan, principally because the *dioptrie* is not yet universally employed, and because it is often of more concern to the practitioner to know the focal length of a lens than its dioptric power.

The necessity of a proper adaptation of the spectacle frame to the figure of the face, and of a proper correspondence of the centre of the lenses and pupils, is so evident, that it would not be mentioned but for the frequent inattention to these matters.

Clinical determination and correction of Myopia, Hypermetropia, Presbyopia, and Astigmatism.

Myopia has been defined as the construction of eye in which the posterior principal focus lies in front of the retina, and therefore the remotest point of distinct sight (r) is situated at a finite distance in front of the eye. With the determination of r the presence and the degree of myopia are ascertained; and r is given by the focal length, expressed in inches, of the weakest concave glass which renders distinct the letters in the test-scale placed twenty feet off; in other words, by the focal length of the glass which imparts to the parallel rays incident from these letters upon the eye the direction of rays proceeding from a less distant point before the eye, upon which they would fall with just sufficient divergence to be collected by the refraction of the eye exactly upon its retina. This less distant point is the remotest point of distinct vision.

Popularly, near-sightedness comprises many imperfections of sight which have only this in common, that the book or needlework must be brought very near, and distant objects are very imperfectly perceived. Therefore not much value should be attached to the complaint of being near-sighted, but a book of test-types should be given to the supposed myope, and the maximum distances noted at which he can read the smaller types. If these distances are less than those at which the same types are read by emmetropic eyes, the supposed myope is next shown the scale of larger letters placed at the distance of twenty feet, and if he does not distinctly see these with the unaided eye, a series of concave glasses are successively held before it, and the weakest glass ascertained with which these letters are made distinct; if the focal length of this glass should be 12 inches, there is myopia of $\frac{1}{12}$, and r is 12 inches distant in front of the eye, augmented by the $\frac{1}{2}$ inch which intervenes between the optical centre of the glass and the common nodal point of the eye. This in the slighter degrees of myopia is of little moment, but in high degrees must be taken into account. In the slighter degrees of myopia this glass may be worn always, but in high degrees of myopia a weaker glass should be used for nearer objects than completely corrects the myopia. Thus, with myopia of $\frac{1}{6}$, a glass of $\frac{1}{9}$ may be given for reading music at 18 inches. In the highest degrees of myopia, as $\frac{1}{2}$ to $\frac{1}{4}$, glasses which do not completely neutralise the myopia will very often be preferred, as more comfortable even for infinitely distant objects.

In hypermetropia the posterior principal focus, as has been already explained, is behind the retina, so that even the parallel rays incident upon the eye from infinitely distant objects cannot be united upon the retina without an accommodative

effort, and such effort must be increased proportionately to the greater divergence of the incident rays as an object lies closer to the eye. Sustained occupation upon small or near objects, as reading or needlework, therefore soon causes fatigue; and it is this which usually compels hypermetropic subjects to seek advice. They very frequently come with the statement that they see well enough for a short time, but then the print or the needlework becomes confused, the letters or stitches seem to swim and to run together, and this more toward the close of the day than in the morning. When the distant test-scale is viewed through a convex lens which renders convergent the parallel rays incident upon it from the letters, these appear as clear or much clearer through the lens than when seen with the unaided eye. The ability to see distant objects distinctly through a convex lens establishes the presence of hypermetropia. The strongest convex lens with which the distant scale is clearly seen gives the amount of manifest hypermetropia. If now the accommodation be paralysed with a strong solution of atropine dropped into the eye at short intervals, several times, the letters in the distant test-scale will be clearly recognised through a much stronger convex glass than before. The reciprocal of the focal length of the glass expresses the total amount of hypermetropia, and the difference between this and the manifest hypermetropia ascertained before the employment of atropine is the amount of latent hypermetropia, *viz.* that which was masked by accommodative effort, which the hypermetropic was unable to suspend at will. In young persons it will be commonly sufficient to neutralise all the manifest hypermetropia; in other words, to allow the strongest glass through which, without the use of atropine, distant objects are clearly recognised, and such glasses may be constantly worn.

Presbyopia.—This, though not strictly a form of ametropia, since it is the natural condition of the emmetropic eye in advanced life, will be conveniently considered here. It has already been pointed out that throughout life, from childhood to old age, the proximate point (p) of distinct vision is constantly receding from the eye—with such recession a time arrives when occupation with small and near objects becomes difficult, especially by artificial light. There is difficulty in threading the needle; the book is held further off, and soon laid down; the eyes are quickly tired. It is found that these difficulties arise when p has receded to beyond eight inches from the eye. This distance has, therefore, been selected as the term at which presbyopia, P, begins. Its degree is given by the reciprocal of the focal length of the convex lens, the dioptric power of which brings back the actual proximate point p, ascertained by measurement with the optometer, to the arbitrary term 8 inches. Thus, supposing p is found to $=24$ inches, then $\frac{1}{8}-\frac{1}{24}=\frac{1}{12}$. In which 12 inches is the focal length of the convex lens, which will bring back p to 8 inches, and $\frac{1}{12}$ the dioptric power, which expresses the degree of presbyopia, P.

The troubles incident to presbyopia are to be met by the use of convex spectacles. These, when only very slight degrees of presbyopia are present, should clear and sharpen the type, but not sensibly enlarge it. At first they will usually be found requisite only, or chiefly, at night; later, they will come into use by day, and somewhat stronger glasses be preferred at night. In advanced age, when senile tissue-deterioration has dulled the transparence of the media and blunted the sensitiveness of the retina, preference will be given to glasses which sensibly enlarge, and these may safely be allowed.

Astigmatism.—A simple and ready method of detecting astigmatism is to ascertain whether bars, each composed of two or three parallel lines, radiating from a centre like the spokes of a wheel, are all simultaneously seen with equal distinctness. Should one bar appear more distinct than the others, astigmatism is present. For less intelligent persons, unused to observe, a single bar of lines which can be turned round upon a disc like the hand of a clock is a preferable test. As this revolves, one position will be found in which it is seen distinctly, or less indistinctly than in other positions. The refraction of the eye is now taken with a spherical lens, in the meridian perpendicular to the less indistinct line; the bar is then rotated through 90°, and the refraction taken in the opposite meridian.

An example will make this more easily intelligible. A person with defective sight cannot recognise smaller letters than 50 in the test scale at 20 feet distance.

A weak spherical convex glass increases the indistinctness of the letters; a weak concave glass helps somewhat, but does not enable him to discern No. 30 type; this visual acuteness is expressed by $V=\frac{20}{30}$, and spherical glasses do not materially help, convex, distinctly reducing the acuteness. No general myopia or hypermetropia is present. On viewing the radiating bars, one is noticed in which the lines appear sharply defined; whilst, in the bar perpendicular to this, the lines appear confused or are quite unrecognisable, the bar itself appearing as a blurred band. A spherical concave lens, of 30 inches negative focal length, renders the horizontal bar as distinct as was previously the perpendicular bar. The vertical meridian of the eye refracts $\frac{1}{30}$ too strongly; there is myopia of $\frac{1}{30}$ in this meridian. A cylindrical glass of $\frac{1}{30}$ placed before the eye, with its axis coincident with the horizontal meridian of the eye, clears the vertical bar, and also clears the smaller types in the test-scale, increasing V to $\frac{20}{20}$. This glass may be constantly worn. If the vertical bar had required a concave spherical lens of $\frac{1}{30}$ to clear it, and the horizontal bar needed the addition of another lens of $\frac{1}{30}$ to make it also clear, the case would have been one of compound astigmatism, and required for its correction a spherical glass of $\frac{1}{30}$, with the addition of a cylinder of $\frac{1}{30}$, which is obtained by having one surface of the lens ground to a spherical curve of 30 inches, and the other to a cylindrical curve of 30 inches.

Substituting convex for concave lenses, this illustration holds good for hypermetropia. Again, if upon examination the vertical bar had required for its distinct perception a concave glass of $\frac{1}{30}$, and the horizontal bar a convex glass of $\frac{1}{30}$, mixed astigmatism is present, which requires for its correction a double cylinder of these strengths.

CHAPTER II.

EXAMINATION OF THE EYE.

Superficial Examination.

The Conjunctiva and Cornea.—The ocular portion of the former of these structures is open to the surgeon's observation, and, to explore the lining of the lower lid, it is only necessary to depress the tarsus with the point of the finger. It is often difficult to obtain a satisfactory view of the cornea in a child suffering from *Ophthalmia*, when light causes so much pain, that the child makes every effort to exclude it, by keeping the eyelids firmly pressed together, and even, in severe cases, thrusting his face against the pillow, or the dress of the attendant.

The surgeon does but waste his time who attempts to coax or parley with such a patient. He should sit and firmly fix between his knees the head of the child. The extreme tip of the forefinger, with a bit of rag twisted over it to prevent slipping, having been laid upon the middle of the upper tarsus, at the very edge of the lid, without any dragging of the skin, is to be steadily pushed upwards and backwards. In this way the greater part of the cornea is at once exposed; but, if the finger is allowed to drag the skin of the lid, the tarsal cartilage instantly becomes tilted over, and the swollen conjunctiva, bulging forwards, hides the eyeball from view. By a similar manœuvre the lower lid may be depressed; but this is not necessary in examining the cornea, for that part is always rolled upwards to seek the shelter of the upper lid.

Where there is much swelling a speculum may be employed, adapted, as regards width and strength of spring, to the small size of the palpebral fissure.

To expose the inner surface of the upper lid, it must be everted, as if the surgeon were in search of a foreign body. Whenever a patient complains of having had a fragment of anything blown into the eye, and a careful scrutiny of the edges of the tarsi, the fold of the lower lid, and the surface of the globe, has failed to reveal the cause of irritation, the upper lid should be turned out by placing a small pen, the extreme feather end of which is cut off, so as to leave a stem just thick enough to

resist bending, across it above the upper border of its cartilage; then, while the finger and thumb of the other hand grasp the eyelashes growing from the middle of the lid, the pen is pressed a little downwards, at the same moment that the lid is drawn first a little forwards, and then upwards; the tarsus will tilt and turn over, so as to expose its conjunctival surface. If, at the moment the turn is being given to the lid, the patient is told to look downwards, the eversion is much more readily accomplished.

Minute foreign bodies, which have fixed themselves beneath the upper lid, are usually found near its tarsal margin. It is when situated here that they cause such distress in the movements of the eyelid over the cornea. When lodged in the conjunctival sinus above the tarsal cartilage, they are liable to scarcely any displacement in winking, do not rub the cornea, and often cause very slight annoyance. They should be lightly picked off with the feather or nib of the pen used for effecting the eversion. A pen is not only more convenient than a probe, but it has the advantage of appearing less formidable to a timid patient.

The cornea, anterior chamber, iris, lens, and the more superficial part of the vitreous humour, can be more searchingly examined when illuminated by a pencil of light thrown obliquely upon them with a convex lens of short focal length than is possible without such aid. The parts under illumination may be advantageously viewed through a magnifier. In the examination of the cornea, the illuminating pencil is brought to a focus upon its surface, when any irregularities, unevennesses, and opacities become apparent by directly reflected light, or the pencil may be focussed on the iris and the cornea seen by light transmitted through it after reflection from the iris.

The lens cannot be fully seen until the pupil has been widely dilated with atropine; but, inasmuch as this dilatation alters the visual condition of the eye, all particulars as to the patient's range and distinctness of sight should be noted before the atropine is applied. Slight opacities may easily elude detection unless care is taken, particularly when very strong illumination is employed. In the lenses of old persons, internal reflections caused by differences in the refractive indices of the fibrous tissue and thin planar sheets produce under oblique illumination an opalescence which closely simulates actual opacity.

The contractility of the iris is tested by shading the eye with the hand for a second or two, and then quickly withdrawing it, so as to allow the light to fall suddenly upon the pupil, the other eye meantime being closed. The consensual action of the irides should next be examined, by observing how far light admitted to one eye influences the pupil of the other.

The separate examination of each eye is a very important point, for cases occur in which, while one eye is sound, the other is so utterly blind as to have lost all perception of light, yet the pupil of this blind eye will contract as soon as light is admitted to the sound one. An extensive adhesion between the edge of the pupil and the capsule of the lens (*Synechia posterior*) would at once attract notice; but, if any slight deviation from the healthy round form of the pupil exists, its margin must be carefully examined, to see if any very small adhesion be the cause of such irregularity. A very slight synechia often affords a valuable hint towards diagnosis, as proving that iritis must at some period or other have attacked the eye. Persistent traces of the fœtal pupillary membrane may be distinguished from the adhesions due to acquired iritis by their attachment to the lesser circle of the iris and not to the margin of the pupil. Whenever the surgeon is in doubt as to the existence of adhesions, the application of atropine will determine the question.

It should ever be borne in mind that a dilated and inactive pupil by no means necessarily implies that the retina is diseased; nor an active pupil that the retina is sound.

The simple modes of examination hitherto mentioned have at all times been at the surgeon's command; I come now to consider the use of an instrument—the *Ophthalmoscope*—the invention of which has enabled us to explore those deeply-seated structures previously altogether beyond the range of observation.

It is now little more than thirty-five years ago since Cumming first demonstrated that by a certain arrangement of illumination the bottom of the healthy human eye could be rendered visible so far as to allow its brilliant reflex being seen. Failing to comprehend the cause of the blackness of the pupil under ordinary circumstances of illumination, he just missed making a great discovery. Six years later the solution of the phenomenon was given by Helmholtz. The blackness of the pupil had previously been ascribed to extinction by the choroid of the rays of light, which, having entered the eye, and traversed the retina, fell on this pigmented coat. Helmholtz showed it to be the necessary effect of refraction. Sufficient rays are reflected from the bottom of the eye to render visible the parts there situated; but since these reflected rays in emerging from the eye must traverse the same ocular media through which they passed in entering the eye, it is evident that they must undergo the same refraction which, as entering rays, they underwent, only in an opposite direction: the result of this is that the paths of the emerging and entering rays coincide, and the former will therefore return to the source whence, as incident rays, they originally started. From this it is evident that an observer cannot bring his eye into the path of the rays reflected from the bottom of another person's eye without by the same act intercepting the rays incident from the source of illumination upon this latter: and since the observer's eye cannot receive from the bottom of the other eye any rays except those which it originally sent to it (and under ordinary circumstances of illumination it sends none), the observer sees in the blackness of the pupil of the other eye merely the reproduction of the blackness of his own pupil.

When the eye under observation is not truly accommodated for the source of illumination, the rays reflected from the bottom of the eye will not all return to the point whence they originally proceeded, but they will form about this a dispersion circle, and if the observer bring his eye within the limits of this circle, it will receive some of the returning rays, and the pupil of the observed eye will appear to glow brightly. This is what occurs in Cumming's experiment. Having solved the cause of the blackness of the pupil, Helmholtz contrived a speculum which made it possible for the observer to bring his eye into the path of the returning rays reflected from the bottom of the eye under observation, without cutting off the rays incident on this from the source of illumination. Of this invention it may be said, without exaggeration, that it marked the beginning of exact diagnosis of the deeper diseases of the eye.

As invented by Helmholtz, the first speculum oculi, or ophthalmoscope, consisted of a reflector of superposed slips of plain glass, mounted in a frame placed obliquely upon one end of a short metal tube, the other end of which was countersunk for the reception of a lens. With this instrument Helmholtz was able to see the optic nerve and larger blood-vessels of the retina.

Its form being inconvenient, and its illuminating power relatively weak, this ophthalmoscope was early superseded by others. It would much exceed the scope of this article to notice the numerous modifications it has undergone. Those now most generally used are concave mirrors of silvered glass or metal, with a small central sight-hole; and an arrangement behind the mirror for the reception of one, or of a series of lenses in a revolving disc which can be brought in succession behind the aperture.

With any of these instruments the refraction and transparence of the ocular media, and coarse structural arrangements of the coats forming the posterior segment of the eyeball, may be ascertained.

Two methods of examination, termed the direct and the indirect, are employed.

In the direct method the parts themselves are viewed directly. Their virtual image, enlarged and erect, is behind the eye. That it is erect is easily ascertained by noticing that, when the observer makes slight movements from side to side, or up and down, the image appears to undergo displacement always in the same direction; and that it is a virtual image is rendered evident by the fact that its sharpness does not suffer when the observer approaches his eye towards the observed eye, until the

distance between them has become so small as to seriously interfere with efficient illumination.

When patient or surgeon is myopic, a neutralising lens should be placed behind the mirror; and when the examination is for the purpose of determining the refraction, concave and convex lenses will be required, the power of which will represent the degree of ametropia present.

The direct method is useful for the examination of the ocular media, or where a considerable enlargement is desired. Its disadvantage is the smallness of its field. An inconvenience attending its use is the necessity of the observer bringing his eye within a very short distance of that of the patient.

In the indirect method a collecting lens of short focal length is used with the mirror, and it is not the bottom of the patient's eye which is seen, but an inverted real image of it situated before the eye, at a distance from it which will vary with the refraction of the eye, the focal length of the collecting lens, and the distance between this and the eye.

The enlargement is less than by the direct method, but it can be increased by placing a second convex lens behind the mirror, which acts the part of the ocular in a compound microscope. The chief advantage of the indirect method is the large field it affords.

Before commencing a thorough examination of a case, it is necessary to dilate the pupil with atropine, unless it has become permanently dilated from disease. In many instances, however, where a glance at the optic nerve and the parts adjacent is all that is required, it is unnecessary to subject the patient to this inconvenience.

The observer and the patient sit face to face in a room from which daylight is excluded; the only source of illumination being a lamp, or, still better, a jet of gas issuing from a jointed tube, so that the flame can be placed higher or lower according to the height of the patient's head. The flame should be on a level with his eye, and just far enough behind it to prevent any of the direct rays falling on his cornea. The chimney surrounding the flame must be of transparent glass, and, if faintly tinged with blue, it will modify the red rays, and impart to them a whiteness nearly resembling that of ordinary daylight. The observer places the back of the mirror close to his own eye, so that he looks through the central aperture, and holds the instrument at such an angle that the reflected light from it falls into the patient's pupil. This is always very difficult for a beginner to accomplish; but a little practice soon makes it easy. He will know that he holds the instrument in the right position by seeing the pupil assume a brilliant reddish appearance.

Still holding the ophthalmoscope in the same position, where the indirect method is employed, he takes in the other hand a convex glass, of two inches or two inches and a half focus, and places it at about this distance in front of the cornea. If the fundus of the eye be properly illuminated, and the convex glass correctly placed, and the observer's eye be properly accommodated for the distance of the real inverted aereal image, some of the retinal vessels will now be distinctly seen. The observer is often confused by seeing a small bright image of the mirror reflected from the surface of the object-lens. This image can be got rid of by giving to the lens a slight inclination.

By turning the eye in various directions, every portion of the retina is successively brought under the view of the observer. The necessity for varying the position of the eye constitutes a great objection to the more complicated ophthalmoscopes, which are fixed to a table or other support; and some eyes are so unsteady, and so little under the patient's control, that the observer is obliged to follow their movements by slight changes in the position of the ophthalmoscope, which can only be effected when the instrument is held in the hand.

Ophthalmoscopic Appearances of the Eye in a healthy state.
(Plate I. figs. 1 and 2.)

In the heading of this section I use the word 'healthy' with a certain latitude of meaning; for, apart from any serious disease, the mere advance of age imprints

upon the internal tissues of the eye certain changes of appearance, which, although deviating from an ideal standard of perfect health, can hardly be termed morbid. At present, I wish to present to the reader merely a sketch of what he is to look for in an eye which fairly performs its functions as an organ of vision.

Optic Nerve and Retina.—Since the intraocular end of the optic nerve is not exactly in the axis of the eyeball, but slightly inwards from this, in order to bring it into view, the patient must direct the eye a little towards the nose, or whilst the patient looks straight before him, the examiner brings his own eye into a line which includes with the axis of the patient's eye an angle of about 15° at its outer side.

The figure of the nerve is a circular or slightly oval disc, with a small central depression where the nerve fibres are deflected on all sides, known as the physiological pit, and a gently elevated margin where the aggregate nerve bundles for the whole retina bend over the choroidal opening. With attention a double contour indicating the edges of the scleral and choroidal openings may be made out. The colour of the peripheral portion of the disc is a delicate greyish pink, whilst the central part is brighter and whiter, with a faint tinge of blue. This coloration is the combined effect of the blood in its vessels, the glistening connective substance of the lamina cribrosa, and the greyish nerve fibres. It is greatly influenced by the intensity of illumination. Our judgment of the colour of the optic nerve is greatly affected by the intensity of pigmentation of the choroid : thus where the choroid is very dark, as in swarthy persons, the optic nerve by contrast appears whiter, and where the choroid contains a minimum of pigment, as is usual in fair persons, the colour of the optic nerve does not so greatly differ from that of the surrounding fundus oculi.

The retinal artery and vein traverse the centre of the disc, or as commonly pierce it eccentrically, in which case they appear nearer its inner side. The number and arrangement of their large branches depend on the early division of the main trunks within the cylinder of the nerve, or their later division near the inner surface of the disc. The artery, distinguished from the vein by its smaller calibre and its brighter red or scarlet colour, very commonly first divides at the surface of the disc into an upper and a lower primary branch, which subdivide towards the periphery of the disc, and thence pass over the border of the nerve into the retina. The veins, which are larger than the arteries, and of a deeper red or crimson colour, usually leave the surface of the disc separately, and unite in a single trunk within the nerve. Besides these large branches, the disc is usually pierced by numerous small arterial and venous offsets, derived from the main trunks within the nerve before their final division.

The retinal vessels give very distinct images, and can be followed from the optic nerve forwards towards the periphery of the retina. The principal arterial branches divide dichotomously, and their course is straighter than that of the veins, which run tortuously and receive tributary veinlets at large angles. The upper and lower hemispheres of the retina each receives two or more large arterial and venous branches. Those which are distributed to the outer segment of the retina diverge as they approach the yellow spot, passing above and below it, so that this part is supplied by capillaries only.

In the largest vessels within the nerve-disc, under a sufficient enlargement and good illumination, a practised observer may recognise slight pulsations, more readily seen in the veins. These pulsations become conspicuous where the tension of the eyeball is heightened in disease, and also in some disorders of the circulation dependent on cardiac disease.

The living retina, though a sufficiently good reflector of light, is so transparent that its recognition demands some practice in the use of the ophthalmoscope. It is most easily recognised in eyes in which the choroid abounds in pigment, which damps the splendour of the sclerotic reflex, and prevents its overpowering the fainter retinal image. This appears in such eyes as a thin bluish haze overlying the choroid. The yellow spot, which lies at the posterior pole of the eyeball, has a circular or oval form often indicated by a bright ring. It is distinguished by a slight difference in the quality of its reflex, from that of the part of the fundus oculi around it, than which it is slightly duller, and by the greater intensity of the choroidal pigmentation.

Choroid.—The red colour of the fundus of the living eye, which first strikes the observer, is due to the coloration given by the choroid to the light which traverses it after reflection at the inner surface of the sclerotic. The tint is the combined effect of the blood in its vessels, and of the pigment which is contained in its epithelium, and in the branched cells which form so large a portion of its stroma. Thus a small amount of pigment imparts a bright, clear, red colour, with a slight orange tinge. In such a choroid the ciliary arteries may be traced from the neighbourhood of the optic nerve forwards towards the equator, and the vasa vorticosa form conspicuous objects. More pigment imparts a decided orange. This is most intense in the spaces between the larger veins, which appear as light red bands between the darker spaces (Plate III., fig. 1). A larger quantity of pigment gives an orange brown, and still more pigment imparts a deep brown colour tinged with violet. In the eyes of black races such intense coloration of the choroid entirely hides its blood-vessels.

CHAPTER III.

DISEASES OF THE CONJUNCTIVA AND SCLEROTIC.

(*Ophthalmia ; Conjunctivitis.*)

Inflammation of the conjunctiva, I need hardly say, accompanies many of the inflammatory processes originating in other tissues of the eyeball. In the present chapter I confine myself to those cases in which the inflammation originates in the conjunctiva, and is either limited to it, or spreads only to the sclerotic.

Inflammatory redness differs very remarkably in these two structures. It is on the inner surface of the lids, and at their point of junction with the globe, that the conjunctival vessels are largest, and their redness is most strongly marked ; and the colour becomes paler as the vessels diminish in size on approaching the cornea. The sclerotic vessels, on the contrary, are most visible close to the cornea, around which they form a pink circle, known as the *sclerotic zone*—a very characteristic mark of several important forms of disease in the deep-seated tissues of the eye. Even if the sclerotic be uniformly injected throughout its whole extent, this injection cannot be traced very far back from the edge of the cornea, because the redness soon becomes hidden beneath the fibrous insertions of the recti muscles. The vessels of the sclerotic are small, closely set together, and so interlaced with the proper fibres of the part that the individual trunks cannot be recognised ; they merely produce the effect of a uniform tint of colour, nearly resembling that of carmine. The conjunctival vessels, for the most part, are plainly seen, and, except in that high stage of inflammation termed *chemosis*, they can be observed repeatedly to anastomose, so as to form a closely-set network.

Elaborate classifications of the various forms of ophthalmia are to be found in many of the systematic works on eye-diseases ; but minute distinctions, however plausible they may look on paper, are of little or no use to the practitioner. In selecting a few heads, under which to group the varieties of ophthalmia, I have been guided by the very decided peculiarities which certain forms present, or by the marked difference in the treatment they require. Many of the slighter forms of conjunctival redness, not resulting from direct violence or the presence of foreign bodies, are due to atmospheric changes ; and the cases described by authors under the name *simple ophthalmia* are, for the most part, mild cases of catarrhal inflammation. When the sclerotic also is affected, the term *rheumatic* is sometimes added ; and Mackenzie uses the words 'catarrho-rheumatic' to signify that both the conjunctiva and the sclerotic are inflamed, although the inflammation may be due to the mere external agency of cold, and not to the presence of rheumatic poison in the blood of the patient.

Congestion of the conjunctiva may also be due to overwork, especially by artificial light, and to strain of the eyes in ametropia, either in consequence of the omission to wear spectacles, or of the use of improper spectacles.

Slight attacks of redness of the conjunctiva are commonly attended with only trifling uneasiness. The enlarged vessels, projecting above the level of the membrane, suggest to the patient the notion of foreign bodies, sand or dust, between the lids and the globe. But in other instances, where the redness is very trifling, the pain is of a neuralgic character, and it is for the irritation existing in the ophthalmic division of the fifth nerve that the patient seeks medical aid. It is important for the practitioner to remember that in such cases the suffering may be really severe, although there is far less appearance of inflammation than in other cases where pain can hardly be said to exist.

Whenever a case of ophthalmia is seen for the first time, the margins of the lids and the puncta lacrymalia should be carefully explored, as a few irregular eyelashes, or even a single eyelash, lodged in one of the puncta, may be causing the irritation.

It sometimes happens that a foreign body, lodged under the upper lid, sets up a considerable amount of ophthalmia, and yet the patient is not aware of any such cause of irritation being present. It is almost invariably found within a line or two of the tarsal margin.

After its removal the application of a piece of linen, dipped in iced water, usually soon relieves all inconvenience.

When the surgeon has satisfied himself that the redness of the conjunctiva is not caused or kept up by any mechanical irritation, he is not at once to prescribe a lotion or drops as a mere matter of routine. I shall hereafter have occasion to speak of the invaluable properties of a local stimulant in cases of true *catarrhal ophthalmia*; but at present I am considering those varying forms of conjunctival redness which are described by most writers under the name of *simple ophthalmia*. It is the surgeon's business to note well the general aspect of the patient: to ascertain what is faulty in respect of digestion, general nervous power, condition of the circulation; whether the ophthalmia can be traced to over-use of the eyes, exposure to irritating or vitiated air, want of exercise, excess in the use of stimulants, tobacco, &c.; in short, a rapid survey is to be taken of whatever is faulty in the patient's general health, and, in most cases, when this has been done, and the proper medical and dietetic means have been taken to correct what is amiss, the ophthalmia is already in a fair way of being cured.

As a rule, local congestion of the conjunctival vessels is met with in feeble and languid patients, who require tonics—iron, or quinine, or mineral acids, and a corresponding plan of diet. Of course there are many cases in which an excess of stimulants, and general over-feeding, have disturbed the due balance of the patient's circulation, and where a restricted and well-regulated diet is absolutely essential. But even in such cases a careful and moderate use of tonics is often necessary. What I wish to guard my readers against is the habit, which has been handed down to us from early times, of regarding all inflammations of the eye as necessarily to be treated by depletion, leeches, and low diet. The very reverse of this is the truth. The popular notion that a leech or two to the temples, and a purgative, must needs cut short an attack of inflammation in the eye is shared by only too many of the old school of practitioners. In young children especially such treatment is most mischievous. From the age of one or two years up to puberty, ulceration of the cornea is what we have most to fear, and this is sometimes attended with so slight a degree of redness of the conjunctiva and sclerotic, that it is important for the surgeon to be aware of this fact, and not to overlook slight attacks of ophthalmia in such subjects, but in every case to look carefully to the condition of the cornea.

While I so strongly insist on the great importance of general treatment in ophthalmia, I by no means exclude the use of local remedies. Where much intolerance of light exists, a small blister to the temple, or the application of tincture of iodine to the skin of the upper lid, will often afford great and immediate relief. Bathing the eyes night and morning with warm water is of great use in some

irritable patients; while in other cases the use of cold water is indicated. Those persons especially who have induced a congested state of the conjunctival vessels by prolonged exposure to artificial light, are often greatly relieved by a plentiful sluicing of the closed lids with cold water night and morning. Where there is agglutination of the lids during sleep, a little vaseline may be smeared on the eyelashes at bed-time. Weak solutions of acetate of lead or alum, or zinc-sulphate ($\frac{1}{2}$ grain to 1 grain to an ounce of distilled water) are useful in chronic cases; but they should be used sparingly, and never for too long a time. After a few days they should be left off, and the part allowed to recover its natural tone, the stimulant being resumed if necessary; but it should never be uninterruptedly continued for weeks or even months, as patients are only too fond of doing.

There are certain forms of ophthalmia which present such distinctive characteristics that they are very properly known by special names. Such are the *Catarrhal*, the *Purulent* (including the *Infantile* and the *Gonorrhœal* forms), the *Pustular*, and the *Chronic*. The disease commonly termed *Scrofulous Ophthalmia* should rather be classed among the diseases of the cornea; and the same may be said of the *Exanthematous* ophthalmia of authors; for it is the cornea which chiefly suffers, either by ulceration or sloughing, in consequence of the low state of vitality following the various forms of exanthematous disease. The term chronic, although of course applicable to any slow and protracted form of disease, when applied to ophthalmia is usually understood to mean an affection of the palpebral conjunctiva, the caruncle and semilunar fold, and the margin of the lids, which is either developed as an independent disease, or remains as a sequela of an acute attack of catarrhal or purulent inflammation.

Catarrhal Ophthalmia.

This is commonly caused by exposure to draughts of cold air, but it is by no means limited to the cold season of the year. It frequently attacks large numbers of persons during the extreme heat of July or August, especially if, as often happens, an east wind prevails at the same time.

A well-marked case of catarrhal ophthalmia presents the following appearances: the cornea is quite clear, and vision is unimpaired, or only occasionally obstructed by the passage of thickened mucus across the area of the pupil. The conjunctiva of the lids is redder than natural, and the injection is particularly marked at the point of reflection of the conjunctiva from the lower lid to the globe. The semilunar fold and caruncle are red and much swollen, especially the former, and this enlargement of the semilunar fold often remains long after all other traces of the ophthalmia have subsided. The surface of the globe presents a network of vessels which gradually becomes less marked as it approaches the cornea. In some cases the sclerotic is involved, and then the peculiar pink zone is seen reaching close up to the margin of the cornea.

A peculiar characteristic of true catarrhal ophthalmia is the existence of numerous red blotches at various parts of the network of vessels, caused by some of these having given way and allowed their blood to become extravasated. The extravasations vary much in size; some are as small as a pin's head, others almost equal the breadth of the cornea.

At the commencement of the attack there is little increase of secretion; subsequently, mucous secretion sets in, which in some cases becomes so profuse as to make the surgeon suspect that the case may be one of true purulent ophthalmia.

There is usually no acute pain in common catarrhal inflammation; but a sense of weight and stiffness in the lids, and, as the disease advances, the enlargement of the vessels suggests to the patient the notion of sand or some other foreign substance between the lids and the globe.

When the sclerotic is much involved, there is usually intolerance of light, and much secretion of tears, and pain either of a dull aching or of an acute darting character. The upper lid, too, frequently becomes œdematous in cases of this mixed kind of sclerotic and conjunctival inflammation, and the infiltration of the subcon-

junctival cellular tissue raises the conjunctiva above the level of the cornea, so as even sometimes to overlap its margin. This elevated condition of the inflamed conjunctiva is termed *Chemosis*.

I need hardly say that a patient who is the subject of catarrhal ophthalmia is frequently disordered in general health, with confined bowels and disturbed digestive functions, and may require appropriate treatment by internal medicines; but very often the ophthalmia comes on without any general ailment, and seems a purely local affection, even limiting itself in some instances to one eye.

Treatment.—When the ophthalmia is unattended with constitutional disturbance, and is confined to the conjunctiva, the local application of nitrate of silver in solution may be regarded almost as a specific. It should be used in the proportion of two grains to the ounce of distilled water, and dropped upon the surface of the eye twice or thrice a day, the conjunctiva being cleansed, by bathing it with warm water, before each application of the drops. At bedtime the eyelashes should be anointed with a little vaseline. Care must be taken not to continue the use of the drops too long, lest the conjunctiva should become bronzed, on which account zinc sulphate is preferable. After being used for a week, they may be omitted for a couple of days, and then resumed as before, if the inflammation appears unsubdued; but often it will be sufficient, after a week's application as above described, to use the drops for a few days longer once a day. In uncomplicated cases, ten days or a fortnight will suffice for the cure; but, if the disease spreads to the sclerotic and cornea, the nitrate of silver must be omitted. The caruncle and semilunar fold are the last to recover their healthy condition after an attack of catarrhal ophthalmia. I have said that the treatment by nitrate of silver is to be adopted when the inflammation is *limited to the conjunctiva*: and it is from want of attention to this point that so much mischief is constantly done. Whenever the sclerotic is much inflamed, and, still more, whenever the cornea is in the least degree implicated, nitrate of silver does nothing but harm.

Phlyctænular or Pustular Ophthalmia.

This is a very common form of ophthalmia, especially among children and young persons. It is characterised by little reddish elevations on the conjunctiva, close to the edge of the cornea, each surrounded by a plexus of blood-vessels. The centre of the little elevations is less vascular, and therefore whiter, than the base, and hence their appearance is a good deal like that of a pustule. When only one or two of these so called phlyctænules are present, they are usually found upon the equator of the eyeball; but sometimes they are more numerous, and almost surround the cornea. Two forms are distinguishable, one in which the phlyctænules are attended with little pain, or intolerance of light, unless the sclerotic be also inflamed; another marked by great intolerance of light, pain, lacrymation, and spasm of eyelids.

Unless there be some derangement of the general health, the treatment of pustular ophthalmia is very simple, but relapses are frequent. When there is little or no intolerance of light, weak astringent solutions of one of the metallic salts, as zinc sulphate or alum, are useful; they should be dropped into the eye twice a day; but in neurotic cases, where intolerance of light is a conspicuous feature, atropine may be advantageously combined with the astringent drop.

Some practitioners attach great value to the local application of calomel in these affections. The calomel, which should be very finely powdered, is to be jerked on to the surface of the eye from a small camel's-hair brush. Others esteem highly an ointment prepared by thoroughly mixing the amorphous yellow mercurial oxide with vaseline in the proportion of gr. xxx. of the former to ʒj of the latter. Neither should be used whilst there is much vascularity, light-shyness, or lacrymation. If, as often occurs, the overflowing tears scald the skin of the eyelids and cheek, these should be anointed with a small quantity of vaseline, or the benzoated zinc oxide ointment (Ph. B.)

The health is usually deranged. Children with phlyctænular ophthalmia are usually feeble, often convalescent from some severe illness. A general tonic treatment

is therefore desirable. Cod-liver oil and iron are most useful. The intense intolerance of light often leads to the child being secluded in a close dark room, and if taken out, its eyes, and sometimes the whole head, are enveloped in wraps. This has the injurious tendency of making such patients still more weakly, and of fostering the intolerance of light. The room should not be very dark; daily outdoor exercise when the weather is favourable should be enjoined; all wraps should be removed from the eyes; a narrow shade standing straight off from the forehead will give all necessary protection.

Purulent Ophthalmia.

(*Suppurative Ophthalmia; Ophthalmo-blenorrhœa; Conjunctivitis puro-mucosa; Ophthalmia contagiosa; Egyptian Ophthalmia; Ophthalmia bellica; Military Ophthalmia.*)

On arriving at the consideration of this form of ophthalmia, we must no longer confine our attention to the conjunctiva; for, although it is in this tissue that the disease commences, it derives all its importance from the fact that the *cornea* is liable to become involved. Much has been written upon the essential differences subsisting between the common purulent ophthalmia of adults, that affecting infants, the Egyptian, and the gonorrhœal ophthalmia; but these various forms, in certain stages of their progress, often resemble each other very closely, so that a severe case of common purulent ophthalmia cannot be distinguished from one of gonorrhœal origin: and the purulent secretion from the eye of an infant suffering from *ophthalmia neonatorum*, if applied to the eye of an adult, may set up all the phenomena of the truly gonorrhœal form. We must not expect, therefore, to be able in every instance to say with certainty, the first time a patient comes before us, 'This is simple purulent ophthalmia;' or, 'This is of gonorrhœal origin;' we must wait until we have had time to watch the progress of the case.

If a patient presents himself in an early stage of purulent ophthalmia, we may, as I have said, be unable to distinguish the disease from the simple catarrhal form; but should the purulent ophthalmia have reached its height, we should find the following appearances.

The patient is generally pale and depressed; the lids are of a dull red, inclining to purple; they are swollen and œdematous, often to such an extent as to prevent the patient separating their margins in the smallest degree. When the surgeon draws them apart, thick yellow secretion oozes from the conjunctival surface, and if allowed to dry, forms a crust, which almost hides the eyelashes from view. The inability to open the eyes very naturally induces the patient to believe that he is blind, and this belief tends still further to depress him both in body and mind. To separate the lids, to cleanse the cornea from the secretion which overspreads it, and thus to give the patient a glimpse of surrounding objects, is often the best means of raising his general powers.

In a case of extreme inflammation such as now being described, the conjunctiva covering the globe is reddened, infiltrated with serum, and raised to a considerable extent above the surface of the sclerotic. This is especially the case immediately around the cornea, the conjunctiva being thrown up into a wall which overlaps the corneal margin. This raised condition of the inflamed conjunctiva constitutes what is termed *chemosis*, a very characteristic mark in this and other forms of severe inflammation. In exploring the surface of the cornea, the surgeon should not content himself with merely cleansing it from secretion by means of a bit of wetted lint or sponge; but with a probe or little spatula he should carefully lift up the overlapping portion of the chemosis, in search of any hidden ulcer; for it is at the extreme edge of the cornea that the ulceration set in, which may eventually go on to perforation.

The milder cases of purulent ophthalmia stop short of the ulcerative stage; and under appropriate treatment the puriform secretion ceases, the conjunctiva gradually loses its unnatural vascularity, and regains its healthy aspect.

The severer cases terminate either in *ulceration* or *slough* of the cornea. The

ulceration usually begins, as I have said, at the corneal margin, and as it extends assumes the form of a more or less deep crescentic groove. Then the ulcer perforates the cornea at some point, and a portion of iris prolapses, producing the appearance of a small dark-coloured nodule at the bottom of the ulcer.

Of course any protrusion of the iris must cause deformity of the pupil, which becomes pear-shaped, oval, or reduced to a narrow slit, in proportion to the amount of iris which has escaped through the ulcer. Sometimes the ulceration spreads as a deep groove quite around the margin of the cornea, so as to isolate its central portion, which stands out in relief, cloudy or wholly opaque. Eventually this central portion becomes involved in the ulcerative process, and then the whole cornea becomes thinned so as to yield to the pressure of the contents of the globe, and forms a bulging mass made up of the remains of the corneal tissue, between the fibres of which dark-coloured portions of exposed iris protrude. At a later period the surface becomes traversed by ramifying blood-vessels. This wholesale destruction of the cornea, however, rarely occurs except in cases of gonorrhœal inflammation. Sometimes purulent ophthalmia, instead of inducing ulceration, ends in *sloughing*. In that case the chemosed conjunctiva encroaches a good deal upon the surface of the cornea; the latter becomes hazy, then opaque and yellowish, and quite dull on the surface; at last it looks almost like a piece of wash-leather, then softens and comes away in shreds; the whole iris bulges forwards, and becomes coated with a fibrous exudation, which eventually transforms the part into a *staphyloma*.

Purulent ophthalmia can undoubtedly be transferred from one eye to another by contact with the secretion. Patients therefore should be cautioned on this point, as also their nurses or attendants. It seems probable that in hot countries, where this ophthalmia is very prevalent, the flies act as propagators of the disease. The dust also of those countries, by keeping the conjunctiva in a state of chronic irritation, no doubt predisposes to the attack. In England the disease, like the common catarrhal form, is, I think, most frequent during the extreme heat which sometimes visits us in July or August, if it be attended, as is often the case, with an east wind.

Treatment.—Although the more rational practice of the present day has effected a vast reform in the treatment of so-called inflammatory diseases, both internal and external, the force of old prejudice and habit has, to a great extent, prevented medical men from applying the same reasoning and common sense to the treatment of eye-diseases which they apply to those of other organs of the body. And, indeed, if a practitioner, unaccustomed to meet with ophthalmic cases, turns in his difficulty to many a work of high authority, he finds such a system of depletion recommended for purulent ophthalmia as is positively frightful.

Purulent ophthalmia, in its severe form, is usually met with in patients who are irritable, pale, and depressed; depletion is therefore inadmissible.

If the patient's bowels have been well relieved, the first requisite is usually a narcotic at bedtime. I almost always give tincture of hyoscyamus, ℥xxv., or ʒss., or even ʒj in camphor-mixture, unless the patient has been habituated to the use of opium, when a moderate dose of that drug may be preferable. It is not easy to lay down positive rules for diet, but it should be such as is best calculated to keep the patient's vital powers to the level of ordinary health; as much of plain nutritious food being taken as the stomach can digest, and just such an amount of stimulants as will aid digestion, and maintain the due vigour of the circulation. Quinine is almost always useful in suitable doses. In short, ulceration and sloughing of the cornea should be combated or guarded against, just on the same principles as those destructive processes would be combated in any other tissue of the body. To a delicate, ill-fed, over-worked woman, attacked with acute purulent ophthalmia, it may be necessary, in addition to a little beer at her dinner, to order a glass of wine twice or thrice a day. To a person in a comfortable position in life, the ordinary amount of stimulants may be amply sufficient, while, with one habitually intemperate a considerable diminution of the accustomed quantity may really effect the desired object, by avoiding that after-depression of the nervous system which invariably follows over-indulgence in drink.

The local treatment of purulent ophthalmia consists in the frequent employment of astringents, such as alum, nitrate of silver, or tannin, dissolved in distilled water. The alum may be used in the proportion of four grains to the ounce of distilled water, dropped into the eye, every hour during the day, and as often during the night as is compatible with the patient's rest. Where the surface of the globe can be well exposed by drawing down the lower lid, it may suffice to squeeze the lotion over it from the rag or a fine sponge. If there be so much swelling of the lids as to make it impossible to expose the surface of the globe, the lotion must be injected beneath the lids with a syringe, first throwing in a little warm water to clear away the discharge. As the case improves, the lotion may be used less frequently, every two or three hours. If nitrate of silver be employed, it should be in the proportion of three or four grains to the ounce, and be dropped upon the surface of the globe three or four times a day, after syringing away the discharge with a little warm water. Or the surface of the conjunctiva may be brushed once a day with a solution of silver nitrate of the strength of gr. v. to ℥j of water. Tannin dissolved in distilled water may be used as a substitute for the alum. Strong solutions of these astringents should be used at longer, weaker at shorter intervals. In some severe cases which assume the violence of the gonorrhœal form, ulceration rapidly extends along the edge of the cornea—usually the lower edge—in the form of a deep crescentic groove. Unless speedily arrested, it penetrates the thickness of the cornea, and if the opening into the anterior chamber be large, so much of the iris may prolapse as greatly to diminish, or wholly to annihilate, the pupillary aperture. In such cases it is sometimes possible to check the spread of the ulcer by rapidly passing over its entire surface a fine point of nitrate of silver. A fine brush dipped in a gr. x. to ℥j solution of the salt is usually the best means of application.

I need hardly allude to the great importance of pure air in the disease now under our notice. In fine weather it is not necessary, even during the acute stage, wholly to confine the patient to the house: and when the ulceration is arrested, and the purulent discharge has ceased, careful and judicious change of air will tend more than anything else to remove the chronic ophthalmia, which is otherwise apt to linger on for a long period.

Gonorrhœal Ophthalmia.

This disease is essentially the same in character as the preceding; but it is far more severe and destructive. It is caused by gonorrhœal matter coming in contact with the conjunctiva; and among the more ignorant classes it is sometimes the result of a very prevalent vulgar error—that a sovereign remedy for sore eyes is to bathe them in the patient's own urine.

I know of no symptom by which we can positively distinguish ordinary purulent ophthalmia from the gonorrhœal form, provided the two diseases are seen at an early stage. Many authors speak of gonorrhœal ophthalmia as almost invariably confining itself to one eye; but this is certainly not the case; and I could relate many instances in which both eyes were attacked within a few days of each other. Indeed, it seems strange that this is not the rule rather than the exception.

Gonorrhœal, like ordinary purulent, ophthalmia begins with redness of the conjunctiva, and a sensation of sand beneath the lids. After a few hours muco-purulent discharge sets in, and the ocular portion of the conjunctiva becomes infiltrated with serum. This thickening rapidly increases and forms a *chemosis*, which is always a very marked symptom in gonorrhœal cases. At the same time the lids become red, and so much swollen that the patient can separate them to only a very slight extent. The cornea becomes hazy; and at this stage an ulcer is almost certain to be found at its margin. Sometimes ulceration begins while the rest of the cornea is still clear; and in that case some care is necessary to detect the loss of substance. A thorough examination of an eye at this stage of the disease cannot be made without the aid of the wire speculum, which prevents the swollen conjunctiva of the lids from bulging over and hiding the cornea. If the margin of the cornea be overlapped by chemosis,

a probe or little spatula should be used to hold it aside, while the surface of the extreme edge of the cornea is wiped perfectly clean with a bit of wetted lint or rag.

Ulceration first attacks the extreme edge of the cornea, and extends in a crescentic form until a considerable portion of the cornea has been cut off from its nutritive supply, and then of course it loses its vitality. In some cases I have seen the ulceration extend all round the corneal margin; and then the central isolated portion, having previously become opaque, has rapidly assumed a softened pulpy appearance, and come away in shreds. The chemosis, which has been so much dreaded as the active agent in the destruction of the cornea, is formed by the infiltration of serum from the overloaded blood-vessels into the subconjunctival cellular tissue.

Patients affected with gonorrhœal ophthalmia are almost always in a state of depression, with weak pulse and deranged digestion. This condition is partly due to the local disease itself, and partly to the distress of mind caused by the fear of impending blindness. It seems extraordinary that surgeons of eminence in times past can have been so far misled by theoretical notions about 'inflammation' as to have overlooked the general condition of these patients, and to have treated them by frightful bleedings, mercury carried to salivation, and other depressing means.

In speaking of purulent ophthalmia I have anticipated the treatment of the gonorrhœal form. It is quite impossible to lay down positive rules as applicable to all cases. Each case becomes a study in itself, and according to the patient's constitution, habits, station of life, and previous treatment, must the surgeon modify his plan. To maintain the digestive functions, to administer suitable quantities of nourishment, to sustain the circulation at a proper point of vigour, neither unnaturally exciting it to hurried action, nor allowing it to flag, and so lead to local congestion of blood, and consequent deterioration of tissues—to secure as far as possible pure air at an equable temperature, to soothe the nervous system, and promote sleep by such mild narcotics as shall not confine the bowels or induce subsequent depression—such is the outline of the general treatment to be pursued.

The local applications I have already indicated, only I would lay still greater stress, in cases of gonorrhœal ophthalmia, upon the utility of nitrate of silver, applied in substance to the conjunctiva and to the surface and edges of the crescentic ulcer. Unless this application be made with great care and neatness of hand, it may do more harm than good. A stick of nitrate of silver can hardly be pointed so sharply as to answer the purpose, and a brush is to be preferred. The lids being held apart with a wire speculum, and the edge of the cornea having been wiped clean, the brush charged with the solution of silver-nitrate is to be lightly passed over the whole surface. This application may require to be repeated upon the following day, but should not be persevered in after the ulceration has ceased to spread, and the puriform character of the discharge has ceased. In the intervals astringent injections should be frequently used. The continuous application of finely broken ice in a small caoutchouc bag is often of great service.

Where one eye only is affected the utmost caution should be observed to protect the other eye from infection. It may be covered with a carefully adjusted compress, or with a watchglass, the circumference of which is secured to the skin around the orbit with a circle of adhesive plaster. Where the chemosis is very great, it has been advised to divide the outer commissure of the eyelids for the purpose of lessening pressure. The writer has never found this necessary, and would prefer the old method of scarifying the œdematous conjunctiva.

In spite of all our efforts and care, it must frequently happen that cases of gonorrhœal ophthalmia terminate in loss of sight. For the disease often occurs in unhealthy subjects, weakened by intemperance and debauchery, and who, before they apply to a regular practitioner, have probably been in the hands of quacks, whose only remedy is mercury. Still, when we consider of what immense importance it may be to retain even a small portion of the cornea in a transparent condition—thereby enabling the surgeon at some future time to make an artificial pupil, and so rescue the patient from blindness—we ought never to give up a case of gonorrhœal ophthalmia so long as any portion of one cornea retains its vitality.

Granular Conjunctiva.

(*Granular Lids; Trachoma.*)

One of the most serious sequelæ of purulent ophthalmia, whether of the simple or the gonorrhœal form, is that condition of the conjunctiva termed 'granular.' During the progress of purulent ophthalmia, the palpebral conjunctiva, when cleansed from secretion, appears villous; and, after the purulent discharge has ceased, this condition of the membrane goes on increasing, until its surface resembles that of a granulating ulcer. The so-called 'granulations,' however, are in reality the follicles and papillæ of the conjunctiva, enlarged by inflammatory deposits. The firmness and solidity of these 'granulations' vary much in different subjects. When hard, and of considerable size, they cause irritability and blinking of the lids, and lacrymation, and after a time the cornea, especially its upper half, becomes hazy, and is traversed by numerous large vessels forming in some cases a complete network, and giving an almost fleshy aspect to the part (*pannus*).

Treatment.—The granulations were long since recognised as causing by their friction the chronic inflammation and vascularity of the cornea; and accordingly, a great variety of plans have at various times been adopted for removing the granulations and restoring smoothness to the palpebral conjunctiva. Complete excision with the knife or scissors, the rapid action of escharotics, and the more gradual wasting by means of astringents, have all in turn been employed against granular lids.

Effectually to cut away the granulations requires such extensive removal of the palpebral conjunctiva as is likely to induce permanent curving of the tarsus and consequent entropion; and the same result may follow the free employment of nitrate of silver. The ordinary astringent lotions of alum, tannin, &c., are powerless in the more severe cases. I have seen much benefit from the acetate of lead, applied by dusting it, in fine powder, over the everted lid. This causes a good deal of pain at the time, but afterwards gives decided relief, apparently by mechanically filling up the interstices of the elevations, and so producing a smooth surface for the eyeball to move upon. The salt as it slowly dissolves, seems also to exert an astringent effect upon the vessels of the enlarged follicles and papillæ, and so to diminish their bulk. But the most effectual means I have ever tried for removing granulations is the undiluted liquor potassæ, applied by dabbing it upon the everted lids, on which it seems to act by chemically saponifying and dissolving away the hypertrophied tissue. The application may be repeated at intervals of a few days; and six or seven weeks of this treatment will sometimes suffice to remove the granulations, and, at the same time, to restore a considerable degree of clearness to the cornea; or the everted eyelids may be brushed with a strong solution of silver nitrate, grains x. to ʒj, the excess being immediately washed off with a current of tepid water in which a little sodium chloride has been dissolved, or the granulations may be rubbed with a smooth crystal of copper sulphate. This should be repeated at intervals of three or four days.

But, every now and then, cases are met with in which the cornea is so opaque, and so traversed by large blood-vessels, as to prevent useful vision, even when the granular state of the lids has been almost subdued. Such instances of opaque and vascular cornea follow severe purulent ophthalmia, especially the form so common in the East, and known to us as Egyptian ophthalmia. Cases of almost equal opacity are met with at our London hospitals among the more destitute Irish patients. It appears that a very severe form of purulent ophthalmia is sometimes epidemic in certain districts of Ireland, rivalling in virulence the disease of tropical countries.[1]

Patients who have been a long time suffering from granular lids in a severe form are almost invariably out of health; often reduced by the violent courses of medicine

[1] Power, in a pamphlet on the Egyptian Ophthalmia, published in 1803, describes a species of the same disease as being 'frequently prevalent among the Irish peasantry, and considered by them to be infectious.' See also a paper by Wilde in the *London Journal of Medical Science*, vol. iii. 1851.

they have undergone, and with the eyes in an irritable condition from long-continued use of caustic applications. To place such patients, if possible, in a pure and bracing air, and to improve their general health by suitable tonics, will be the first indications for treatment. In this way considerable improvement may be induced both in the condition of the lids and of the cornea ; but there will still remain certain inveterate cases, incurable by any ordinary treatment, either local or general. They usually present a granular condition of the palpebral conjunctiva ; this, however, may have been got rid of, or greatly subdued, by treatment : the characteristic sign, which makes the disease so formidable, is the haziness and vascularity of the cornea.

We will suppose a case in which the granular condition of the lids has been partially or wholly cured, and the general health restored : but where, after exhausting every resource of his art, the surgeon still finds the patient's corneæ permanently opaque, and traversed in all directions by vessels, vision being limited to the mere recognition of large objects. There may be every reason to believe that the tissues of the eye posterior to the cornea still remain healthy, and yet the condition of the latter destroys all hope of good vision being regained.

For such desperate cases a seemingly desperate remedy—*inoculation*—has been proposed, consisting in the production of a fresh attack of purulent ophthalmia by applying to the conjunctiva some morbid secretion from the eye of a patient suffering under the acute form of that disease.

This treatment was extensively tried in Germany several years ago, but seems to have fallen into disuse. Its advocates asserted that purulent ophthalmia, thus produced in an eye which had previously undergone the disease, would cause a wasting of the vessels overspreading the cornea, and ultimately restore its transparency. There seemed however a great risk of the second attack proving as severe as the first, and ending in destructive ulceration of the cornea ; and the fact of the inoculation serving to keep up and perpetuate a dangerous and contagious disease, also operated with many surgeons as a reason for wholly discountenancing the practice. These considerations for some time induced me to abstain from the experiment. I had seen cases in which inoculation was followed by perforating ulcer of the cornea ; but, at the same time, I had seen others in which considerable clearing of previously opaque corneæ took place without any ulceration whatever.

The first case in which I tried inoculation was one which seemed peculiarly suitable for it. The patient, a discharged soldier, was in good general health, but quite helpless in consequence of the state of his corneæ. They were so hazy that the position of his pupils could not be traced, and were traversed in every direction by vessels. He had perception of reflected light and colours, but could not distinguish a hand from a sheet of paper, except by the difference of tint. Although the granular state of the lids had been nearly subdued, the condition of the corneæ during three years had been proof against every mode of treatment.

Some pus from the eye of a patient with purulent ophthalmia was applied to each conjunctiva. Intense inflammation set in, and on the third day there was already chemosis with thick purulent discharge. A week later both corneæ were so covered with a yellowish flocculent layer as to appear to be in a state of complete slough. This substance, however, in the course of a few days, had disappeared, and the corneæ were found to be entire, presenting a somewhat translucent aspect, although the chemosis and discharge still continued. As no local application except cold water was permitted, and no astringent used to control the discharge, it continued in a slight degree for some months. Meantime the corneæ, as they became clearer, presented but few traces of the vessels by which they had been so plentifully traversed. Six months after inoculation the patient could recognise features at a distance of twelve feet, and with perfect security could go about the streets of London alone. There still remained such a degree of haziness about the centre of each cornea as prevented him from reading ordinary type, No. 16 of Jaeger's specimens being the smallest characters he could readily make out.

I have since used inoculation repeatedly, and so many cases have been reported by others, that I should not have quoted this single case, except on account of its bearing upon a point which I think has not been sufficiently attended to, namely, the varying results of inoculation in respect of its inducing corneal ulceration.

The vitality of the cornea is put to a very severe test when the suppurative inflammation sets in with such intensity as is exemplified in the case just mentioned. If the cornea be abundantly supplied with blood by vessels traversing it in every

direction, it will probably resist both ulceration and sloughing; whereas, a simple opaque and non-vascular cornea may be destroyed, or at least perforated, on account of mere deficiency of blood-supply. Inoculation should therefore never be practised, unless the entire cornea is pervaded with blood-vessels. The abundant vessels which had prevented the cornea duly performing its function of transmitting light, serve to keep it alive while the inflammatory stage is going on, and so enable it eventually to recover its transparency and usefulness. The very circumstance, therefore, of the cornea being in a hyperæmic condition is favourable, as regards its ability to support the violent means employed for the restoration of its transparency.

Those who for the first time resort to inoculation in a case of corneal opacity, resulting from bygone purulent ophthalmia, will probably be dismayed when they witness the immediate result of their experiment; and will give up the cornea for lost when they see it overlapped and nearly hidden by chemosis, and catch a glimpse of its dead-yellow, slough-like surface. This, however, becomes detached, and leaves beneath it a translucent cornea, which, provided it has been well nourished with blood, may gradually advance in clearness, until it almost loses the marks of its former degeneration.

Throughout the treatment no attempt is to be made to arrest the discharge, cold water only being used as an external application in cleansing the eye. The patient should be allowed a nutritious diet, and on no account undergo depletion.

Even under the most favourable conditions, as regards the patient's general health, and the blood-supply of the cornea, inoculation must be a hazardous experiment; and it should, therefore, be reserved for those cases where the vascular opacity of the cornea has bidden defiance to all other forms of treatment, and has deprived the patient of all useful sight.

Purulent Ophthalmia of Infants.

(*Ophthalmia neonatorum.*)

This disease is closely allied in its symptoms to that just treated of, although not arising from the same specific form of infection.

Both diseases derive all their importance from the liability of the *cornea* to become ulcerated. The cause of *ophthalmia neonatorum* has given rise to much controversy; some regarding it as only an aggravated form of catarrhal ophthalmia, while others consider it as in every case due to contamination with the vaginal discharge of the mother. The latter is perhaps the more probable explanation, the difference in the intensity of the disease depending upon the more or less virulent nature of the discharge.

The ophthalmia begins a few days after birth. It may not for some time assume any intensity, and hence it is often overlooked in its early stage; and we are told that it did not begin till the child was two or three weeks old. When the child is jaundiced, the discharge assumes a deep yellow colour.

The surgeon's first object should be to ascertain to what extent the corneæ are involved. Having secured the infant's head, he should carefully introduce between the lids a wire speculum, of a size and strength of spring proportioned to the small palpebral opening of so young a child. With a bit of moistened lint the discharge should be gently wiped away, so that the surface of the cornea may be thoroughly explored. If an ulcer exists, it will most commonly be found at the centre. It may occupy the whole area of the pupil, or involve all the cornea except its extreme edge, or the iris may be seen protruding through a complete perforation of the cornea in the form of a brownish nodule. If the whole cornea be destroyed, the iris will be seen bulging forward, covered by a thin glaze of semi-transparent inflammatory deposit. Sometimes it seems as if the posterior elastic lamina had resisted the ulcerative process, and still formed a thin coating to the bulging mass of iris. These are the cases which eventually exhibit *staphyloma*; the deposit upon the iris becoming by degrees thicker and denser, and assuming very much the appearance of

opaque, or partially opaque, corneal tissue, over the surface of which, at a later period, arborescent vessels ramify. When the perforating ulcer of the cornea is very large, it not uncommonly happens that the lens escapes through the aperture.

When the purulent ophthalmia is at its height, the lids are red and swollen; but when the cornea has given way, the bright rosy tint of the lids usually gives place to a dull livid colour, the swelling subsides, and the skin becomes flabby. The palpebral conjunctiva, when cleansed from the discharge, appears brightened and villous.

Treatment.—The nutrition of an infant attacked with purulent ophthalmia is so important—as the means whereby the ulcerative process may be averted, or, if that process have already commenced, reparative material may be supplied for filling up the breach—that, before alluding to local treatment, I would insist upon the importance of the child being suckled, and not brought up by hand. A weakly infant, attacked with severe ulceration of the cornea, and fed with artificial food, has hardly a chance of recovery. Of course the condition of the bowels must be attended to; but care must be taken not to lower the child by unnecessary doses of 'grey powder'—that panacea for infantile complaints, according to popular belief. Weakly children are often benefited by a few drops—four or five—of Battley's liquor cinchonæ, given in a tea-spoonful of milk twice a day.

In the local treatment, all depressing and so-called 'antiphlogistic' measures are to be carefully avoided. Blistering is perfectly ineffectual towards controlling the discharge, and only weakens and irritates the general system. Abstraction of blood by leeches is even worse, as depriving the child of that reparative material which is so urgently required for averting or healing ulceration. I know of no application better than a solution of alum, three–five grains to the ounce of distilled water—which should be injected between the lids every half-hour. It is well to inject a little warm water before using the alum-lotion, so as to wash away the discharge, and thus allow the alum to come completely into contact with the inflamed conjunctiva.

As the discharge abates, the lotion may be injected less frequently—every hour, or every two hours. Care must be taken not to chill the infant by wetting its clothes during the injecting.

The condition of the cornea must be carefully inspected from day to day. If there be a large ulcer, and the reparative process have set in, the surgeon must not be uneasy on observing that the surrounding portion of the cornea looks cloudy and reddish. This pink tinge is owing to the presence of blood-vessels, advancing towards the ulcer, and conveying to it reparative material. When the ulcer has become completely filled up, these blood-vessels will gradually disappear, and the peripheral portion of the cornea, in which they ramified, will resume its transparency.

Sometimes it is useful to change the local application, and to use a solution of nitrate of silver—two grains to the ounce—dropping a small quantity on the conjunctiva twice or thrice a day. This change of stimulus often acts beneficially, when the puriform discharge has almost ceased, and the ulcer still shows little disposition to heal. As soon as the ulcer begins to fill up rapidly, the alum or nitrate of silver should be used less frequently.

In severe cases of purulent ophthalmia, eversion of the swollen conjunctiva of the lids frequently occurs. This always gives rise to alarm among those who have charge of the child, and is often a cause of anxiety to the surgeon. It is a matter of no real importance; the eversion cannot easily be controlled by any artificial means, and is sure to cease as soon as the puriform discharge has abated.

Diphtheritic Ophthalmia.

This very destructive affection is fortunately very rarely seen in this country, so rarely indeed, that during an experience of more than twenty years at the largest ophthalmic hospital in the metropolis, the writer has not seen in all half a dozen cases. On the Continent, and particularly in Berlin, it is reported to be not uncommon, and to

sometimes occur epidemically. It is believed to be very infectious. In some cases it engrafts itself upon what at the onset appears to be an ordinary purulent ophthalmia; in others the diphtheritic characters are evident from the onset. The eyelids soon become very swollen and hard, which makes it difficult, if not impossible, to evert them. This brawny hardness contrasts with the soft œdematous swelling of the eyelids which attends an ordinary purulent ophthalmia. There is a similarly firm chemosis of the conjunctiva, which is not intensely red as in a common ophthalmia, but has a pale yellowish tint. Eminently characteristic is the occurrence of membranous exudation on the surface of the conjunctiva. The discharge is copious, and thin, and not distinctly puriform, as in common purulent ophthalmia. The cornea becomes opaque, softened, and is destroyed by ulceration and sloughing. Recession of the diphtheritic condition is marked by softening of the brawny firmness of the eyelids and of the chemosis, increasing redness of the conjunctiva, and by the discharge assuming a puriform character. In the early stage caustics and strong astringent solutions are said to be injurious; their use is to be restricted to the late stage, when the symptoms have come to resemble those of a common purulent ophthalmia. A solution of quina sulphate, recommended by Mr. Tweedy as a topical application, has lately been very favourably reported on by Mr. Adams.

In an early stage, when the more distinctly inflammatory symptoms are very acute, local depletion by the very free use of leeches, and rapid mercurialisation with calomel in doses of gr. i. every two hours, or by inunction, are advocated by continental authorities. The results of this treatment are not very encouraging. Persons in broken or feeble health seem more liable than those in sound health to this disorder, and such persons ill bear loss of blood and mercurialisation. The continuous application of cold, preferably ice, gives ease and seems to influence favourably the course of the process. It should be replaced by warm applications if the cornea is seriously compromised.

Chronic Ophthalmia.

The acute stage of common catarrhal ophthalmia, if neglected, is apt to subside into a chronic form, characterised by a congested state of the palpebral conjunctiva, with an increase in its mucous secretion, an unnatural fulness of the caruncle and semilunar fold, and some degree of redness along the tarsal edges. The patient complains of a sensation like that produced by a small foreign body beneath the lids; luminous bodies appear surrounded by a halo of prismatic colours; the eyes water when exposed to bright light or cold winds; and the lids are gummed together in the morning.

The surgeon, on first seeing such a case, should most carefully explore the edges of the tarsi, to see if any fine eyelashes are growing irregularly, so as to touch and irritate the globe. A single delicate hair, so fine as almost to elude observation, will sometimes suffice to keep up, or even of itself to produce, most of the symptoms I have just described.

Chronic ophthalmia, characterised by the above symptoms, is not always a sequela of acute inflammation. Indeed, it more commonly occurs as a primary disease, in persons whose occupations oblige them to sit for many hours in close and over-heated rooms, while engaged on minute objects, especially under artificial light.

Treatment.—When we consider the various classes of persons liable to chronic ophthalmia, it is obviously impossible to lay down rules of treatment which shall be universally applicable. To rectify whatever may be found amiss in the general health, is the first indication. The injurious effects of artificial light chiefly depend upon the abundance of red rays inseparable from every form of it. These may be modified by adapting to the flame of the lamp, or gas-burner, a chimney or shade of transparent glass slightly tinted with blue. The colour should be so faint as only just to whiten the flame, without imparting to it any decidedly blue tinge.

An immense variety of substances has been used in lotions and drops for the cure of this troublesome affection. Acetate of lead, alum, sulphate of zinc, nitrate of

silver, sulphate of copper, tannin, &c., have all found their special admirers. Vinum opii was long a favourite form of drop; while the more homely washes of diluted brandy or vinegar have found favour as domestic remedies. Whatever form may be preferred, care should be taken not to make the solution too strong, and not to use it for too long a time without intermission. The object should be to stimulate the conjunctiva, for a short period, and then to give it time to resume its natural functions. Many persons, by the habitual use of strong lotions, keep up the very condition they are seeking to cure. Acetate of lead, or alum, in the proportion of from two to four grains in the ounce of water, are perhaps as useful as any of the more common substances. Bathing the eyes in cold water night and morning is in many cases preferable to the use of any medicated lotions. An occasional small blister to the temple is useful when the eyes become suddenly irritable and intolerant of light.

Xerophthalmos.

This affection, which is usually the result of a prolonged subacute ophthalmia, seldom of a single acute attack, is characterised by a cuticular state of the conjunctiva. This loses the moist soft extensile character of a mucous membrane and becomes dry, opaque and scaly. The conjunctival layer of the cornea being implicated, sight is correspondingly blunted, and may diminish to loss of perception of objects. Often the loose conjunctival folds between the eyelids and eyeballs shrink and small bridles pass from lids to globe.

Moistening the opaque cornea with oil or glycerine temporarily lessens the opacity, but the improvement is of short duration. Closure of the eyelids by uniting their free edges for several weeks has also been tried, but the result of this, as indeed of all other treatment, is not encouraging.

Injuries of the Conjunctiva.

The more serious of these are due to contact with escharotics, heated fluids, or melted metal. Slight lacerations or cuts of the conjunctiva, not involving the sclerotic, require only very simple treatment—water-dressing and closure of the lids. Strong mineral acids, caustic alkalies, and other chemical substances, often produce the most destructive effects upon the conjunctiva and cornea, causing bands of adhesion to form between the lids and the globe, and inflicting upon the cornea such an amount of opacity as wholly to destroy sight. The damage in these cases is so instantaneous that the surgeon has hardly ever the opportunity of neutralising the destructive fluid. If at hand at the moment of the accident he would of course at once inject between the lids such a fluid as would chemically decompose the acid or caustic alkali, and form a neutral salt. Afterwards a little castor-oil or olive-oil may be dropped upon the surface of the globe, and water-dressing applied over the closed lids.

Where melted metal has spurted into the eye, the surgeon should always evert the upper lid, and explore all the folds of the conjunctiva; for large portions of metal will sometimes lodge beneath the lids in the most singular manner, and remain there quite unsuspected for a long time.

When lime, mortar, sand, or other solid matters, have been thrown against the eye, the upper lid must be everted, and every particle of grit removed in the most careful manner with a small scoop. In such cases it will not do to trust to injections of water only, although they may be useful after the scoop has done its work. The continuous application of ice to the eyelids is of very great service in reducing the intense inflammation which quickly follows such injuries.

If the surface of the conjunctiva presents an opaque thickened appearance, as if it had been boiled, and the cornea is also of an opaque and pearly hue, the damage to sight is irreparable, and only slight improvement is to be hoped for. In such cases the surgeon must take care not to weaken the patient by bleeding or low diet, for

it is by keeping up the patient's reparative power that the life of the corneal tissue is to be sustained, and sloughing averted. Where a portion of the cornea is densely white and opaque, and the rest only slightly cloudy, the latter part may recover much of its natural transparency.

In those cases where the opposed surfaces of the palpebral and ocular conjunctiva have sloughed, it is impossible to prevent the formation of bands of adhesion; but these may be somewhat limited by the frequent use of a probe, to break down the newly-formed granulations, only wearing a glass shield whilst cicatrization is progressing.

Affections of the Subconjunctival Tissue.

ŒDEMA.

Pressure upon the trunk of the ophthalmic vein or its branches, by obstructing the return of blood from the conjunctiva and subjacent areolar tissue, is liable to produce œdema. In slight cases the œdema is confined to the lower part of the globe, where the distended conjunctiva sometimes overhangs the edge of the lower tarsus: it is only in extreme cases that the œdema extends to the upper part of the globe. In old persons, whose tissues are very lax, I have seen the margin of the cornea overlapped by the œdematous conjunctiva.

Œdema and chemosis differ in degree and kind; the former being a mere exudation of serum in consequence of pressure on the veins leading from the part, while the latter term is restricted to those cases where the conjunctiva and subjacent areolar tissue are actively inflamed. Abscess in the lids or in the lacrymal sac, tumours, and exostoses in the orbit, periosteal thickening in the neighbourhood of the ophthalmic vein—in short, any direct pressure on this vessel, may give rise to œdema, which cannot therefore be regarded as of itself constituting a disease, or as demanding attention, except as a symptom of something more important which has given rise to it.

ECCHYMOSIS.

Some of the small vessels beneath the conjunctiva may give way in consequence of a violent effort, such as coughing or vomiting, or sometimes without any assignable cause; in children with whooping cough such extravasation often takes place to a great extent. The blood may appear as a small patch on the white of the eye, or it may quite hide the sclerotic, and extend up to the edge of the cornea. The appearance is so peculiar that it can never be mistaken for imflammatory injection. In the latter the individual vessels can always be distinguished, while the extravasation presents the uniform aspect of a thinly spread-out clot.

Subconjunctival ecchymosis not uncommonly causes great alarm to the patient; but, except for its unsightliness, it is quite unimportant. The scraped root of the black bryony (*Tamus communis*) made into a poultice with bread crumbs or linseed meal, applied over the closed lids, and renewed every six hours, will hasten the absorption of blood; or the closed lids may be covered with a compress wetted with Liq. plumbi subacet. in the proportion of ʒiv to ℥j of distilled water. If this cannot be worn, frequent sluicing with cold water is the best thing to be done. Nothing, however, will cause the blood to be absorbed until after the lapse of several days.

PINGUECULA.

After the middle period of life, especially in persons who have been much exposed to the weather, or have lived in hot climates, it is very common to see small yellowish elevations on the sclerotic, close to the edge of the cornea, and on the equator of the eyeball. They are sometimes surrounded and traversed by a few fine vessels. When these little elevations attain their full size, they will be observed to have a somewhat triangular form, the base corresponding to the cornea. They have received the name of *pinguecula* from their being supposed to consist of fat; much of their bulk, however, is made up of fibrous tissue. Pingueculæ are growths

so entirely harmless that they would not call for a remark, were it not that they very often give rise to the most serious alarm in the patient, who believes that they will gradually grow over the pupil and obstruct the sight. An explanation of their real nature comprises all that is required on the part of the surgeon.

PTERYGIUM.

This consists in a reddish, fleshy-looking growth extending from the semilunar fold to the cornea, the margin of which it frequently oversteps. It has a triangular shape, its base corresponding to the inner or outer canthus. Occasionally pterygium is present at both sides, and exceptionally they are met with in other situations than the horizontal equator. Slighter forms of this growth are met with, in which, instead of looking like a portion of muscle, the fibres are so thin and delicate as rather to resemble an aponeurosis with a few muscular fibres intermixed. No muscle, however, is found in these growths, which consist of fibrous tissue abundantly intermixed with blood-vessels.

Pterygium, like pinguecula, is found in persons past the middle period of life, and especially among sailors and those who have lived in tropical countries. The dust and glare which are there so abundant, may probably be an exciting cause. A very well-marked case came under my care in a mason and plasterer, who, although always residing in the neighbourhood of London, had of course been much exposed to dust of various kinds. The largest pterygium I ever saw, however, was in a countryman from Essex, in whom the apex of the growth, instead of stopping short of the area of the pupil, as is commonly the case, spread so far across the cornea as almost to hide the whole of the pupil. In this case I removed the growth; and whenever the apex extends so far as to occupy a large portion of the cornea, the deformity it produces may demand an operation. The lids being held asunder with a spring speculum, the lax portion covering the sclerotic is to be nipped up in a forceps, and cut across with a fine scalpel midway between the edge of the cornea and the semilunar fold. The portion extending towards the cornea may then be dissected off the sclerotic, great care being taken when that part is removed which adheres to the cornea. It is well not to remove the inner third of the pterygium, as otherwise the semilunar fold and caruncle are apt to retract, which afterwards gives an unpleasant prominence to the eyeball. The tendency to recurrence is sometimes strongly marked. On this account some have advocated the transplantation of the apex of the pterygium in an upward or downward direction, where, should it continue to grow, it will not encroach upon the cornea and will be hidden by the eyelids.

No other local treatment than removal with the knife or scissors is of any avail in getting rid of a pterygium. Stimulating lotions and drops only excite it to grow; and the varieties of pterygium described by authors, under the names of *sarcomatous*, *fungous*, *cancerous*, and *malignant*, were probably nothing more than common forms of the growth, irritated and teased by escharotics.

FATTY TUMOURS.

Fatty deposits to any large extent beneath the conjunctiva are uncommon. The few cases I have seen occurred in children, and the tumours all occupied the same position, namely, the line of reflection of the conjunctiva from the lower lid on to the globe. They extended from near the lower edge of the cornea to the outer canthus, were of an elongated form, almost resembling a haricot bean, and were partly concealed by the lower lid. On dividing the conjunctiva and the proper fibrous envelope, the fatty mass was easily turned out.

Fibro-cellular. (Dermoid tumours, not cysts).—The lipomata just described differ from those so frequently met with in the subcutaneous tissue of the trunk and limbs in the relatively large amount of fibro-nucleated tissue they contain. Of much less infrequent occurrence than these are little tumours composed almost wholly of a fibro-cellular tissue. They are usually seated near the anterior border of the

sclerotic, or jointly on this and on the cornea. In size they seldom greatly exceed a split pea. Their surface is cuticular, and not infrequently a few fine hairs grow from the summit of the tumour. They are always congenital.

They should be dissected off the surface of the eyeball, care being taken not to carry the knife too deeply into the cornea.

Polypi.—Small, innocent, pedunculated tumours of the conjunctiva are occasionally observed. They almost invariably spring from the palpebral conjunctiva and usually near the sinus. I have only seen them in relation with the lower eyelids. They should be snipped off.

Cancer.—Primary cancer of the conjunctiva is very rare. The few instances which have come under my notice were epitheliomatous; they occurred on the ocular conjunctiva and had a distinctly papillose, warty character. Thorough excision and cauterisation of the wound with nitrate of silver in two instances procured a long immunity from return; in another case recurrence necessitated excision of the eyeball.

CYSTICERCUS TELÆ CELLULOSÆ.

This parasite is occasionally found in the subconjunctival cellular tissue, but it appears to be of very rare occurrence. I have seen but two instances, both in females, one patient being six, the other eighteen, years old. The appearance was that of a rounded body, about as large as a pea, midway between the inner canthus and the cornea. There was a good deal of vascularity in the conjunctiva covering and surrounding it. In the first case a little watery bladder, rather larger than a pin's head, had been observed about eighteen months before the patient was brought to me. In the second case, no account could be given as to the first appearance of the growth. On the conjunctiva being divided, the cysticercus slipped out, and was at once recognised under the microscope. Sichel, in his *Iconographie*, gives a very good figure of a cysticercus in the position I have described (pl. lxxii. fig. 2), and also of one developed beneath the plica semilunaris (fig. 1). In other figures of the same plate, the animal is shown both in its natural size and magnified.[1]

At the time I saw these two cases the connection between the development of tænia in the intestines, and of cysticercus in other parts of the body, had not been pointed out; nor was it suspected that two creatures so dissimilar were really the same animal under different forms of development.[2]

STAINS FROM NITRATE OF SILVER.

Before quitting the subject of affections of the conjunctiva and subjacent tissue, I may say a few words respecting the serious disfigurement which results from the prolonged use of nitrate of silver in solution. No surgeon who understands the real action of this substance—its invaluable efficacy in catarrhal ophthalmia, and its inutility or injurious effects in affections of the cornea—would be likely to employ it in such a manner as to produce permanent staining of the tissues of the eye; for in no case is its prolonged use of any service; the good it does, it does in a few days. Patients, however, have such unbounded faith in the efficacy of eye-drops and eye-waters, that they will frequently continue the use of them for months and even years.

One of the worst cases of staining with nitrate of silver I ever saw was the following. A woman, with incurable opacity at the centre of the cornea—the cicatrix of an ulcer, in fact—had been ordered to use drops of nitrate of silver. This she did for some months, under a surgeon's advice. She then went to another part of the country, but still continued the use of the drops, putting in, as she assured me, 'two drops every day for *ten years*.' The whole of her sclerotic was of a dirty sepia tint, most marked towards the lower part of the

[1] Gräfe mentions five cases of subconjunctival cysticercus as having occurred in his *clinique* during a period of thirteen years. *Archiv für Ophthalmologie*, xii. 2, 174.

[2] See Küchenmeister, *On Animal and Vegetable Parasites of the Human Body*; and Von Siebold, *On Tape and Cystic Worms*; published by the Sydenham Society, 1857. See also the essay on PARASITES in the Appendix.

globe. The cornea itself slightly partook of the same tint, and the conjunctiva of the lower lid, thickened and vascular, looked as if a brush dipped in liquid sepia had been passed over it, the dull red colour of the conjunctiva being only seen where the membrane had formed a fold.

In another case, where this discoloration existed in a less marked degree than in the case just mentioned, I tried the effect of a solution of cyanide of potassium. The patient was an intelligent man, and could thoroughly understand the principle of the treatment, which was to keep the whole surface of stained tissue for a lengthened period in contact with the fluid. This was effected by the help of an 'eye-glass,' and I told the patient to draw down the lower lid, and to fix it against the cheek-bone with the rim of the glass, before throwing his head back. After several months but little benefit had resulted, and I then tried a solution of hyposulphite of soda, beginning with a strength of ten grains to the ounce of water—as the effect of the substance was unknown to me—and gradually increasing it up to a drachm to the ounce. The change effected was very slow, but when I last saw the patient the stain was barely traceable on close inspection.

CHAPTER IV.

DISEASES OF THE CORNEA.

Thoroughly to appreciate the slight changes in the cornea which are capable of affecting the sight, the surgeon should clearly understand that the normal condition of the part consists in absolute transparency of its whole thickness, and perfect polish of its surface; every deviation from these conditions is an evidence of some morbid action.

When a healthy eye is examined near a window, the image of the window-frame ought to be depicted on the surface of the cornea with the most perfect sharpness and clearness of detail. A slight amount of inflammation, just enough to cause some thickening of the epithelium, destroys the brilliant polish, and causes the image of the window to appear blurred and dull, and the lines of the sash-bars crooked and wavy. This appearance is often important as giving notice that inflammation of other tissues of the eye may be going on: as in the early stage of Glaucoma, where this dull condition of the epithelium is always to be seen.

Conical Cornea.

(*Staphyloma corneæ pellucidum; Keratoconus.*)

This curious and rare [1] malformation consists in a change in the form of the cornea from a segment of a sphere to a cone, the transparency of the part remaining unaltered. It is met with in both sexes, in women much more frequently than in men. It is almost unknown in childhood; it usually begins late in youth, or in young adult life, and its subjects are generally delicate.

The aspect of a patient with conical cornea in a high degree is so peculiar that, when once seen, the affection can never afterwards be overlooked. The eye, viewed in front, has a brilliant and sparkling appearance, as if a tear were hanging just in front of the pupil. When seen in profile, the conical shape of the cornea is at once recognised. The position of the iris is unchanged, and its movements are perfectly natural; nor is any other tissue, except the cornea, observed to be affected. In saying that a conical cornea is perfectly transparent, I should modify the remark as far as concerns the extreme apex of the cone, which sometimes, when viewed closely, presents an appearance of slight opacity. In some cases this seems due to an actual

[1] That the disease is very rare may be seen by reference to a table which I contributed to the *London Journal of Medicine* (vol. ii. 1850), showing the number of cases of conical cornea occurring among the patients annually received at the Moorfields Hospital from 1819 to 1849.

haziness in the tissue itself; but the appearance is frequently caused by mere refraction of the rays of light. There seems no good reason for attributing this slight cloudiness of the apex of the cone to the friction of the lids.

The apex of the cone usually corresponds to the centre of the cornea; but not infrequently in slight cases it has been observed to deviate from this position. When obliquely illuminated with a collecting lens, or with the ophthalmoscopic mirror, the side of the cone on which the light falls gives a brilliant reflex, which contrasts strongly with the dark opposite side of the cone. In both methods of ophthalmoscopic examination, the images of the retinal vessels appear greatly disturbed, slight movements of the eye or of the examiner impart to such images an illusory circular motion around the base of the cone. Short-sightedness is often the first noticed symptom, but, as the change goes on, a remarkable refraction of the rays of light is produced; the flame of a candle appears surrounded with a halo, then it seems to be divided into a multitude of diverging rays, and sometimes, instead of a single flame, several flames are seen, arranged in a circle; the myopia is complicated with very irregular astigmatism. When the last stage of conical deformity has been reached, the patient cannot read, even at the shortest focus.

In the few cases in which conical corneæ have been dissected, the apex of the cone has been found very much thinned.[1] The mode in which the disease originates is at present quite unexplained; and in proportion to the obscurity which attends its cause have arisen the most varied suggestions for its treatment. Repeated evacuations of the aqueous humour, the same operation followed by pressure on the cornea, removal of the lens by extraction or solution, these, and perhaps other forms of operation, were formerly tried, but without benefit.

Tyrrell tried the effect of displacing the pupil towards the corneal margin. With the blunt hook he invented, he drew out a small piece of the iris, and cut it off, leaving a portion of the cut tissue entangled in the wound. His object was to bring the pupil opposite the flatter portion of the cone; but the result did not answer his expectations. A better form of this operation has been lately devised, whereby the pupil is transformed into a long narrow chink, reaching quite across the cornea. A small wound is made close to the corneal margin, a blunt hook or fine forceps is introduced, and the pupillary portion of the iris, having been drawn out, is tied with a fine ligature, *Iridodesis*. At a later period, when the corneal wound is healed, and the aqueous humour retained, a similar operation is performed on the opposite side of the cornea. This operation should, I think, be limited to those extreme cases of conical deformity which cannot be palliated by an optical contrivance.

The occasional occurrence of iritis after iridodesis has very generally led ophthalmic surgeons to abandon it, and where an operation on the iris is deemed advisable, to practise, instead of iridodesis, a very narrow iridectomy. The excision of a very narrow segment of the iris is sometimes followed by considerable improvement of sight. Free excision of a large segment of the iris, invaluable for the relief of undue tension of the eyeball in glaucoma, has been tried in conical cornea, with the hope that the conicity might lessen after it; but this has not been realised, and the great dispersion entailed by the very large pupil not being counterbalanced by recession of the cornea, this operation has been relinquished. Von Gräfe, observing the contraction which follows cicatrisation, shaved off the apex of the cone, taking care not to remove the whole thickness of the cornea, and cauterised the wound with nitrate of silver, which prevented too rapid healing. The flattening of the cone thus produced effected in some instances not inconsiderable visual improvement. The details of this operation were improved by Mr. Bowman, who removed the apex of the cone with a minute trephine. The disfigurement by the opaque white scar may be lessened by subsequently tattooing it, which also has the advantage of rendering the scar more impervious to light, and thus lessening the confusion produced by dispersion.

The depletory measures formerly practised are not only useless, but positively

[1] *Royal London Ophthalmic Hospital Reports*, vol. ii. p. 155.

hurtful. An attempt should be made to improve the health by fresh air, sufficient and suitable food and tonics; all strain of the eyes should be avoided.

Slight cases are sometimes benefited by spherical concave glasses, alone or in combination with a cylinder; but in the complete stage of the disease, the sight is little, if at all, aided by glasses of any kind. A small aperture, like a pin-hole, in a metallic plate, held close to the eye, will in most cases of confirmed conical deformity enable a patient to read at a distance of five or six inches who previously had been unable to discern a letter. If, instead of a hole, a slit about three-quarters of an inch long and the thirtieth of an inch wide be made in a metallic plate fixed into a spectacle-frame, a considerable extent of lateral vision is obtained, without any necessity for moving the head in the way which is necessary when objects are viewed merely through a small circular aperture. It was the benefit derived from this slit in a metallic diaphragm which suggested the operation of iridodesis just described.

Arcus Senilis.

This term is by no means well chosen, for the change in the cornea which it implies commences long before old age can be said to have arrived, and by the time the patient has reached the age of sixty or seventy, the arc has usually been converted into a complete circle. Canton described the appearance as being due to a fatty degeneration of the peripheral portion of the cornea; and the term 'arcus adiposus' would therefore be well applied to its early stage, and 'annulus adiposus' to that condition in which the white ring completely encircles the cornea. In many persons past forty years of age, in some even at a much earlier period, an opaque whitish crescent may be observed skirting the margin of the cornea, either at its upper or lower part. This opaque crescent is the commencement of the so-called 'arcus senilis;' and on close inspection it will be seen that the opacity is not an extension of the white tissue of the sclerotic into that of the cornea, but that a narrow interval of partially clear cornea always intervenes between the two opaque structures. In some old persons, the circle assumes a chalky whiteness, and presents a very striking appearance.

'Arcus senilis' is considered by some observers to indicate the co-existence of fatty degeneration of the heart. As far as the eye itself is concerned, the change can be considered as of very little importance. It certainly does not, as has been asserted, in any way contra-indicate the operation of cataract by extraction; for I have many times carried my section through a strongly-marked 'arcus senilis,' and the wound has become quickly and firmly united.

Inflammation of the Cornea.

(*Keratitis; Corneitis.*)

The healthy cornea, as I have already observed, is of the most perfect transparency, and its surface smooth and brilliant in the highest degree. These qualities are lost as soon as the part becomes inflamed; a general haziness overspreads the whole structure, and the surface looks like a steamy glass.

If the inflammation be acute, a crescentic plexus of vessels will be seen passing from the edge of the cornea for some little distance—a line or more—into its substance. These vessels are so fine, and so closely set together, that they produce the appearance of a small patch of blood smeared upon the surface of the cornea. With a lens of an inch focus, the individual vessels composing the plexus may be identified. This characteristic plexus sometimes involves a third or even a half of the corneal circumference.

A zone of pink vessels is always seen in the sclerotic adjacent to the cornea, whenever any form of active keratitis is present; this *sclerotic zone* also exists whenever the iris is inflamed. It is therefore always to be regarded as an important sign. As acute keratitis advances, some portion of the hazy cornea may become more

decidedly opaque, and of a pale yellow tint; this shows that softening is going on, which may lead to actual giving way of the part. Intolerance of light and abundant secretion of tears accompany keratitis. The larger venous trunks of the conjunctiva become full and distended, but there is an absence of that fine vascular network in the conjunctiva which characterises ophthalmia.

One eye is usually attacked at a time, but the other may sooner or later become involved, and it very often happens that the second eye becomes inflamed just as the first is recovering.

Children and young persons are the most frequent subjects of keratitis, and the disease is rare after the age of twenty. The subjects of it are usually of a weakly, irritable constitution, often pale and anæmic; in some cases presenting the swollen cervical glands and other marks of scrofula.

The prognosis is favourable in proportion as the patient is young, and is seen at an early stage of the disease.

The mischievous and too common practice of keeping such patients confined to darkened rooms often induces a morbid irritability of the nervous system, and an intolerance of light, which is still further aggravated by the irritating drops so unsparingly applied to eyes affected with corneal inflammation.

Under judicious management a case of keratitis occurring in a child may sometimes pass off without leaving a trace of opacity. But when the disease occurs after puberty, and is severe and obstinate, perfect transparency is hardly ever restored, and the cornea remains ever afterwards rather more convex than natural, and very faintly mottled with opacities and partially transparent interstices. These opacities resulting from long-continued keratitis, without ulceration, require to be thoroughly understood; for the surgeon who has not made himself familiar with their appearance will be sure to overrate the patient's powers of sight. It seems as if long-continued keratitis in patients who have passed childhood were attended with some peculiar change in the structure of the cornea, whereby those portions which present only the slightest traces of opacity become, from irregular refraction of the rays of light, unable to transmit a clear and well-defined image of objects.

Treatment.—I have already alluded to the constitutional peculiarities commonly met with in patients who are the subjects of keratitis. They are in every way unfitted to endure the 'antiphlogistic' measures recommended in so many works on eye-diseases. The diet should be nutritious and abundant, but not given in such quantities as to oppress the stomach and impair digestion. Very young children are almost always better without beer or wine. The former should be given to older children once a day if they have been accustomed to it; but wine can only be required by children suffering from extreme debility; in ordinary cases it hurries the circulation, and increases the general irritability of the nervous system. Of course the condition of the bowels is to be carefully attended to; and where the state of the biliary and other secretions may demand the use of mercury, an occasional dose of calomel—one or two grains, with or without a proportionate quantity of rhubarb—is to be given; but anything like a mercurial course is to be avoided. Iron is, of all substances, the most beneficial in cases of genuine keratitis, but it frequently fails in consequence of being given in too large doses, and for too long a time without any pause. The tinctura ferri sesquichloridi is the form I usually prefer, giving it invariably directly after food, or even during a meal, and in doses varying, according to age, from five to twelve drops twice a day. The syrupus ferri iodidi is sometimes useful. Occasionally, when the patient is feeble, ill-nourished, or of phthisical tendency, cod-liver oil may be given as well as the iron, or even, for a time, instead of it.

Counter-irritation, by means of small blisters to the temples, is often valuable in combating the intolerance of light; and tincture of iodine, applied to the skin of the lids, also conduces to the same end, and is preferable to blisters in patients of extreme delicacy of constitution.

Inflammation of the cornea is essentially a tedious disease, and the surgeon must often wait patiently for weeks, and even months, before the transparency of the part is restored. Hence it will be seen how necessary it is to give the tonic medicines in

small doses, such as the patient can go on with for a considerable period, instead of attempting to conquer the disease at once by giving large doses, which cannot be persevered in without derangement of the stomach and liver.

Warm fomentations, night and morning, or steaming the eyes over hot water, will usually be found to allay their irritability; but all stimulating lotions and drops do harm.

How any one who has seen much ophthalmic practice can recommend the application of solid nitrate of silver to the conjunctiva in cases of keratitis, I cannot comprehend. The same substance in solution, and the sulphates of copper and zinc, are also frequently employed, and sometimes the ointments of the nitrate and nitrico-oxide of mercury are added, as if on purpose to increase the irritation already existing.

'Scrofulous or Strumous Keratitis.'

I have observed that the well-known disease commonly called Scrofulous Ophthalmia (*Phlyctænular Ophthalmia* of Mackenzie) derives all its importance from the fact that the cornea is implicated; and I therefore propose to separate the disease from the group of conjunctival inflammations, to which alone the term 'Ophthalmia' strictly belongs, and to treat of it under the head of Inflammation of the Cornea.

It specially attacks children, but certainly is not always confined to those of scrofulous constitution; at least it is met with where there is no evidence of tubercular disease. The most striking symptom is extreme intolerance of light (*photophobia*), and general irritability of the eyes and of the whole system. The local affection of the cornea shows itself either in a small whitish elevation (*phlyctænula*), or an ulcer. In either case a long plexus of vessels runs from the corneal margin to the morbid spot. This long plexus or lash of vessels is quite diagnostic of the disease. It is sometimes seen when the rest of the cornea is almost clear, but more commonly there are several phlyctænulæ or ulcers, and the whole of the cornea is more or less hazy. The intolerance of light I have mentioned, as being characteristic of the disease, causes violent spasm of the orbicularis palpebrarum, which is increased when the surgeon makes any attempt to examine the eyes. The intolerance is often much increased by the too common but most injudicious practice of keeping the patients in dark rooms. After many hours of darkness, the sudden admission of light is of course extremely painful. If the intolerance is very great, or the child too young to be open to persuasion, the examination must be made by means of the wire speculum.

The pain caused by exposure to light is often out of all proportion to the extent of corneal disease. In some extreme cases the surgeon is surprised to find merely a small whitish elevation (*phlyctænula*), or an ulcer the size of a pin's head, with the characteristic streak of vessels reaching to it from the edge of an almost clear cornea.

In true cases of this form of keratitis there is hardly any increase in the mucous secretion from the conjunctiva, but the flow of tears is profuse, and they gush out each time the lids are separated. There is a more or less marked zone of vessels in the sclerotic immediately around the cornea, but no general redness of the globe, the chief increase of vascularity being due to distension of the larger veins of the conjunctiva. The lids are often raw and excoriated at the edges, and the outer commissure is inclined to crack and bleed. Swollen and fissured lips and alæ nasi, excoriations and cracks behind the ears, eczema on various parts of the face, and eruptions on the scalp, are occasionally found to accompany this disease of the eyes in the more severe and long-continued cases.

Treatment.—Both the skill and patience of the surgeon are often severely tried by these cases, especially if they have been neglected, or treated injudiciously, before coming into his hands. Long-continued doses of mercury, seclusion in dark rooms involving the loss of air and exercise, and too much of food and stimulants, are the

common sources of unsuccess as regards general management, whilst the local application is too often just that which is most hurtful—namely, nitrate of silver.

Under the head of Catarrhal Ophthalmia I have spoken of the valuable properties of this substance in solution, in cases where the inflammation is limited to the conjunctiva; and I have also mentioned how beneficially the application of the solid nitrate acts in arresting the rapid ulceration of the cornea in purulent or gonorrhœal ophthalmia. But the too common practice of dropping-in a solution of the nitrate in cases where the cornea is attacked either with phlyctænulæ or ulcers, is most mischievous, and often prevents the cure of a case which in other respects may have been judiciously treated.

I have said that children attacked with this disease should by no means be shut up in dark rooms. Light is as essential to the health of animals as of plants, and all inconvenience from bright light can be averted by the use of a large shade, or in elder children a pair of tinted spectacles. Out of doors a blue or green veil may be added. Moderate exercise in the open air should be taken whenever the weather is mild and dry, and sea-air is generally the most desirable, provided the place selected be not too bleak and windy. I have alluded to the ill effects of too much food and stimulants; but in doing so, I would not be supposed to recommend low diet; on the contrary, there should be an abundance of nutritious, easily digested food. My remark was directed against that pernicious practice of stuffing young children with more animal food than the stomach can properly digest, and over-exciting their irritable circulation with wine and beer, as if their disease could, as it were, be taken by storm and extinguished by mere eating and drinking. Of course there are exceptional instances of very weakly children who require a small quantity of wine; but, as a rule, beer is preferable at an early age, and to those unaccustomed to stimulants pure milk will often be found of far more service.

With respect to drugs, I know of nothing so useful as iron in cases of keratitis, whether attended with phlyctænulæ or ulcers. It may be given alone, or in combination with quinine, according to circumstances. The reason why iron is so often ineffectually prescribed in this disease and in many others, appears to me to be that it is given in too large doses and at wrong times. The form I prefer is the tinctura ferri sesquichloridi, in doses of five, ten, or twelve drops, twice or thrice a day, to children ranging from five to fifteen years of age. It is best taken in water, and always immediately after a meal. Weakly children may at the same time take with advantage cod-liver oil. Every fortnight or so the iron may be discontinued for a couple of days, and if the bowels have become confined, or the liver appear to be deranged, a mild aperient may then be taken, with half a grain, a grain, or two grains of calomel, according to age and constitution.

Of local applications none are so generally employed as blisters; and no doubt, when used judiciously, they are very serviceable in subduing that intolerance of light which is one of the most distressing features of the disease. But here again a great mistake is frequently made in applying blisters of too large a size, and without sufficiently discriminating between those constitutions that will and those that will not bear them.

In feeble anæmic subjects a blister, even of small size, will often produce considerable depression; and in very young children with irritable skin, will bring out a troublesome eczematous eruption. The best effect is produced by applying blisters the size of a shilling to the temple, allowing the part to heal quickly, and repeating the blister when the cuticle is reproduced at the end of a week or ten days. A more rapid form of counter-irritation is that produced by undiluted tincture of iodine, painted on the skin of the upper lid. This may be repeated as often as the skin recovers its natural condition.

The lids may be bathed night and morning with warm water, or the steam of hot water may be allowed to play against them, which avoids the mechanical irritation of rags or sponges.

Vaseline may be smeared along the eyelashes at bedtime. Lotions of acetate of lead, or alum, two or three grains to the ounce of water, are sometimes useful where

there is on the cornea merely a small opaque patch (phlyctæna), with the characteristic lash of vessels running to it; but whenever an ulcer exists lead-lotions are improper, as the carbonate of lead, which is precipitated from them, is liable to form an insoluble white deposit in the cicatrix.

Leeches always do harm in cases of true keratitis with ulceration of the cornea.

To get rid of the plexus of vessels running from the edge of the cornea to the phlyctænula or ulcer on its surface, it has been gravely proposed that the vessels should be cut across with a lancet. This is, indeed, beginning at the wrong end. '*Ubi stimulus, ibi affluxus*;' so long as an irritable patch of deposit or an ulcer exists, so long will an irregular supply of blood be sent thither. Heal the ulcer, or get rid of the irritability of the cornea, by constitutional means, and the plexus of vessels will vanish.

The opacities remaining after a long-continued attack of scrofulous ophthalmia are, to a certain extent, permanent; that is to say, if they result from the healing of ulcers. But if the ulcer be superficial and the child very young, it is surprising to see how faint a trace remains in after-life, to mark the site of the cicatrix.

Parenchymatous or Interstitial Keratitis.

It is to the careful observations of Hutchinson that we owe the true knowledge of this remarkable form of corneal inflammation. Not that he detected a disease which had never been seen before; on the contrary, it was in patients who might have been selected as affording typical specimens of 'strumous ophthalmia' that he first declared the morbid appearances to be due, not to scrofula, but to inherited syphilis. He named the disease 'chronic interstitial keratitis;' but I think we may fairly substitute the shorter term *syphilitic*. No confusion can arise from thus naming the disease, because there is no special form of corneal inflammation connected with acquired syphilis, the chronic interstitial form being met with exclusively as a sequela of an *inherited* taint. [I have exceptionally seen this form of keratitis follow acquired syphilis in young adults free from every evidence of antecedent inherited taint, and less infrequently in children, from whom all other grounds for suspecting inherited syphilis were absent.—J. W. H.]

The subjects of this form of keratitis are children and young persons from five to eighteen years of age, and most frequently it is an eldest child that comes under observation. The disease begins at the centre of one cornea, in the form of a diffused haziness, like that of ground glass. Very soon whitish dots appear in the midst of the haze, not on the surface, but in the very substance of the cornea. These dots generally run together, and thus increase the amount of central opacity. At first there is but little attendant vascularity of the sclerotic and conjunctiva, but as the central opacity becomes more marked, these tissues become reddened, and a fine plexus of vessels spreads on the cornea itself, and gradually pervades the opaque portion, affecting the upper and central part of the cornea in preference to its lower half. Throughout the whole course of the disease there is no tendency to ulceration.

Usually within about two months—or it may be much earlier—the other cornea begins to be affected, the disease commencing, as in the eye first attacked, by a central haziness.

The vascularity of the cornea, when the disease is at its height, is wholly unlike that which attends granular lids, and other chronic forms of keratitis. In the latter the vessels are large and superficial, whereas in the disease now under consideration they penetrate the cornea so deeply, and are so fine and closely set together, that the effect produced is that of a tissue infiltrated with blood.

'In almost all cases the subjects of this keratitis,' says Hutchinson, 'present a very peculiar physiognomy, of which the most striking signs are, a coarse flabby skin, pits and scars on the face and forehead, cicatrices of old fissures at the angles of the mouth, sunken bridge to the nose, and a set of permanent teeth peculiar for their smallness, bad colour, and vertically notched edges.' He adds: 'As diagnostic of

hereditary syphilis, various peculiarities are often presented by the other teeth, especially the canines, but the upper central incisors are the *test-teeth*. When first cut, these teeth are usually short, and the cutting edge is narrow from side to side, and very thin. After a while a crescentic portion from their edge breaks away, leaving a broad, shallow, vertical notch, which is permanent for some years, but between twenty and thirty usually becomes obliterated by the premature wearing down of the tooth.' . . . . . 'I have not met with a single example of well-characterised interstitial keratitis in which the teeth were of normal size and shape.'

More extensive experience has caused Mr. Hutchinson to modify this last remark, and he mentions several exceptional cases in which all the appearances of syphilitic keratitis were present, in association with well-formed teeth.

One very remarkable instance of keratitis—I think the severest I ever saw—occurred in my own practice, in a young lady whose teeth were quite remarkable for soundness and symmetry; but in her the peculiar physiognomy was well marked, and her history completely confirmed the fact of her inherited syphilis. I have also seen some striking cases, in which patients with well-formed features, and clear and ruddy complexions, had strongly-marked syphilitic keratitis; but their teeth were more or less affected. We therefore may meet with severe syphilitic keratitis in patients with healthy physiognomy and deformed teeth; or—still more rarely—in those with faultless teeth and the syphilitic cast of features; but to find the true form of keratitis in connection with both good teeth and good complexion also, is, I think, next to impossible.

I frequently notice that medical men who have not read Hutchinson's careful descriptions, but have only heard of 'notched teeth,' expect to find serrated edges, such as one so often sees in newly-cut healthy incisors. 'Serrated,' however, implies a series of notches. A single notch is that to which Hutchinson first drew attention; and the following figure, copied from his work, will at once show the reader what he is to look for.

Fig. 4.

In adults the notch often becomes worn away, but even then the tooth retains a characteristic shape. I liken it to that of a screw-driver, being wide at the base, where it joins the gum, and narrow at its cutting edge; while its lateral edges are thick and rounded. The lower incisors never lose their peculiar form, which is more or less cylindrical, and they are commonly wider apart than healthy teeth.

It must be always borne in mind that these syphilitic peculiarities in the teeth are only met with in the permanent set. The first set are not notched, but they are usually stunted and prone to premature decay.

Treatment.—A combined specific and tonic plan is advocated by Hutchinson, as being more efficacious than one exclusively tonic, and he advises the cautious use of mercurials and iodides. He prefers to administer the mercury by rubbing-in the milder ointment, always avoiding ptyalism, and gives internally iodide of potassium and iodide of iron.

I believe iron, under some form or other, to be the one drug needful. It should be given in small doses, because the cure is necessarily very slow, and the medicine must therefore be continued for many months. An occasional small dose of calomel—a grain or so once a fortnight—is requisite to prevent the iron deranging the liver, but I do not think 'a mercurial course,' as it is termed, either necessary or beneficial. The forms of iron I prefer are the tinctura ferri sesquichloridi, and syrup. ferri iodidi. For a young child six or seven years of age, eight or ten drops of the tincture, given once a day immediately after a meal, will be a full dose; each fortnight it may be left off for a day or two, and a grain of calomel given. Even for

patients sixteen or eighteen years old, the dose of the tincture need never exceed fifteen or twenty drops.

Good diet, pure air, and all things calculated to improve the condition of the blood and tissues, are of the utmost importance in treating the cachectic subjects of inherited syphilis. The surgeon must ever bear in mind that the severer forms of syphilitic keratitis require a very long time for their cure. A bad case will require a year or even longer, and the friends of the patient ought at the very first to clearly understand this. A rapid cure is quite impossible. If only the vascularity of the cornea disappears, and from month to month the part becomes less opaque, the very worst case may terminate satisfactorily. It is, however, unreasonable to expect that in very severe cases absolute transparency of the cornea will ever be attained.

A very chronic kind of iritis commonly accompanies the severer forms of syphilitic keratitis, and the consequent deposits in the pupil, or around its margin, are first detected when the cornea is recovering its transparency.

Keratitis with Suppuration.

In simple inflammation of the cornea, the opacity, however dense it may be, consists of inflammatory exudation among the lamellæ of the part, without any destruction of the lamellæ themselves. Under certain conditions of the patient's system, however, the inflammation may run a very acute and rapid course, and within a few days terminate in suppuration or ulceration.

When suppuration takes place in the substance of the cornea, it is most frequently at the centre, or a little below that spot, that the pus collects. Its presence is usually manifested by a small yellowish patch in the midst of the general haziness. In very severe cases this yellow patch may rapidly spread, until the whole cornea assumes one uniform creamy tint, entirely hiding every trace of iris; the cornea then softens, and gives way at some part, the iris prolapses, and vision is eventually lost.

These are extreme cases: a more ordinary form of suppuration is that in which the pus gradually infiltrates the lower third, or even the lower half, of the cornea, and at last makes its way through the posterior elastic lamina, and then sinks down to the bottom of the anterior chamber, where it forms what is termed *hypopyon*.[1]

The giving way of the posterior elastic lamina of the cornea is sometimes speedily followed by that of the anterior lamina, and in that case a perforation is established, through which a prolapsus of the iris takes place. This perforation of the cornea is followed by immediate relief of the severe pain which had existed as long as the pus was pent up among the fibres of the cornea, or in the anterior chamber. This pain is often severe to a degree quite incredible to those who have never witnessed such cases, assuming the form of neuralgia, and wholly preventing sleep.

Treatment.—In general surgery we are so accustomed, whenever an abscess forms, to regard its evacuation as the very first indication for treatment, that I may be expected to mention a puncture for giving exit to the pus, as the most important step in treating a case of suppuration in the cornea. But, although it is common to speak of *abscess* in this part, the matter is not contained in a distinct cavity, but is infiltrated among the corneal fibres, so that if an incision be made, the pus does not flow out. The cornea, too, differs from every other superficial tissue of the body, in being transparent; and we should avoid inflicting any unnecessary wound, even to the smallest extent, upon a structure, the transparency of which is essential to sight.

[It is now generally admitted that an incision through the suppurating spot will often limit the suppuration and consequently the destruction of the corneal tissue, and give instant relief to pain.—J. W. H.]

[1] This collection of pus at the bottom of the anterior chamber is by some authors termed *onyx*; others use the latter word—now almost obsolete—to signify an abscess in the substance of the cornea.

The general tonic plan of treatment I have sketched out as suitable to cases of common keratitis will be applicable, with certain modifications, to keratitis with suppuration. We must take care not to reduce the patient's vital powers; for, if we do, not only will the softening of the corneal tissue be likely to spread, but if perforation of the cornea takes place, there will be a deficiency of reparative material to fill up the breach, and a large prolapsus iridis, with consequent distortion or obliteration of the pupillary opening, will be the result.

In the very early stage of suppuration, when a small yellowish patch in the midst of the hazy cornea is all that is seen to mark the beginning of suppuration, blistering to the temple sometimes aids in checking the formation of pus; but when a considerable portion of the cornea has become infiltrated, and severe neuralgia sets in, blistering only aggravates the pain. Narcotics must then be given; to children, a few drops of tincture of hyoscyamus at bedtime; to adults, a fuller dose—℥ss. or ℥j. In very severe cases of neuralgia in the fifth nerve, hyoscyamus will be found unavailing, and morphia must be resorted to, especially if the patient be accustomed to the use of opium. Sometimes a piece of lint steeped in chloroform liniment, and laid upon the temple and forehead, over the region of the lacrymal and supraorbital branches of the fifth nerve, is of great service in lulling the pain.

If the infiltration and softening of the cornea go on to perforation, the aqueous humour at once drains away, and then the neuralgia usually ceases, or is mitigated in a remarkable degree. If the pain ceases, so as to allow the patient to obtain sleep without the aid of narcotics, they ought, as soon as possible, to be laid aside; for they almost invariably take away appetite, and the patient is now in need of good nourishment to hasten the repair of the breach in the cornea.

Bark and ammonia, or quinine, may be required at this stage of the disease; but a carefully-regulated nutritious diet, with a moderate amount of stimulants, must be the chief sources of the reparative process.

As respects local treatment, protection from light, and occasional fomentation with warm water or poppy-decoction, comprise all that is necessary during the earlier stage. When, however, the cornea has given way, the eyelids must be kept constantly closed, either by the application of a strip or two of plaster, or by means of a light pad of cotton-wool, arranged around the eyeball, and kept in its place by a bandage. The eye should only be opened occasionally by the surgeon, to ascertain the progress of repair. In some cases it is useful to abstain from examining the eye for four-and-twenty or eight-and-forty hours.

When prolapsus iridis has occurred, this occlusion of the eye is especially useful, as, by keeping the parts at rest, an opportunity is afforded for the adhesion of the protruded iris to the edges of the aperture in the cornea. As soon as this adhesion has taken place, no more iris can escape, and the prolapsed portion gradually shrinks, and flattens down to the level of the cicatrix. When, from want of vigour in the patient, the adhesive process is sluggish, it is sometimes useful lightly to touch the prolapsus with a point of nitrate of silver, but there is a risk of the inflammation thus provoked extending beyond the prolapsus.

To attempt to return a portion of iris which has prolapsed through a loss of substance in the cornea, is utterly futile; for it will protrude again and again, so long as there exists an aperture for it to escape through.

Disease of the fifth nerve, caused either by pressure on its trunk, as it is emerging by the side of the pons Varolii, or by primary degeneration of the tissue of the nerve itself, will give rise to a form of keratitis with suppuration very similar to that described in the preceding pages. In the cases of disease of the fifth nerve which I have seen, this affection of the cornea has not come on during the neuralgic stage, but at a later period, when, in consequence of partial or total destruction of the trunk of the nerve, there has been anæsthesia of the parts supplied by the ophthalmic division. In three or four cases which I have watched, the whole cornea was not destroyed; but after perforation had occurred, the process of softening ceased, and reparation so far took place that eventually there remained only an opaque cicatrix

in the cornea, to which a portion of the iris adhered.[1] Two opinions are entertained respecting the relation of the nerve-lesion and the ocular disorder. The ophthalmia and corneal ulceration, following the nerve-lesion, have been regarded by some as direct results of the abolition of a trophic influence thought to be exercised by the fifth cranial nerve over the ocular tissues; an opinion which has its origin in Majendie's well-known experiments. Others have looked upon the ocular disorders as the consequences of mechanical and other direct injuries of the occurrence of which, owing to the anæsthesia of the surface of the eyeball, the sufferer is unaware. This opinion is in harmony with Snellen's experiments, and with the facts within the experience of every ophthalmic surgeon, that in such cases small foreign bodies are not infrequently found upon the cornea or under the eyelids, upon a removal of which and closure of the eyelids the ophthalmia usually subsides, and the ulceration of cornea ceases without further treatment.

'Exanthematous Ophthalmia' (so called).

(*Post-febrile ulceration of the cornea; Ophthalmia morbillosa; Ophthalmia scarlatinosa; Ophthalmia variolosa; Ophthalmia erysipelatosa.*)

The various forms of ophthalmia accompanying the exanthemata have been described by some authors with considerable minuteness; but if we restrict the term ophthalmia to signify an inflammation of the conjunctiva, it is perhaps in measles only that any very marked ophthalmia can be said to occur. Taking place, as it does, at the onset of the attack, it is one of the most marked symptoms of the disease, but demands no special treatment. The really important affection connected with measles, is the *ulceration of the cornea*, which results from the general debility produced by the disease. This ulceration is commonly attributable to a neglect of tonic treatment after the inflammatory symptoms have passed away. Iron and quinine, alone or in combination, cod-liver oil, the various influences of fresh air and nutritious diet, are all to be put in requisition to avert or to heal these ulcerations.

Scarlatina, on account of the greater exhaustion of the powers of life which it induces, is still more likely than measles to be followed by ulcers of the cornea. In some extreme cases of this frightful disease, the corneæ lose their vitality, and entirely slough away. The same system of tonics and nutritious diet which I have mentioned as useful in averting the sequelæ of measles, would be still more urgently called for after an attack of scarlatina.

During erysipelas of the head and face, in the severe form, the lids are so completely closed by the swelling of the skin, as to hide the eyes from observation. In the stage of debility succeeding the attack, ulceration of the cornea may arise, as in the two diseases above mentioned; or the cornea may even slough, as in scarlatina.

Of all the exanthemata, small-pox produces the greatest damage to the eyes; and a large proportion of those persons whom we see with shrunken globes, or with their corneæ converted into chalk-like cicatrices, have lost their sight from the ulceration introduced by this disease. It was formerly supposed that these opacities were produced by pustules on the cornea itself; but it has been ascertained that pustules never form on this part, the opacities being invariably the result of ulcers, caused by the extreme prostration which succeeds the inflammatory stage.[2]

[1] In a paper published in the eighteenth volume of the *Medico-Chirurgical Transactions*, 1845, I drew attention to the fact that anæsthesia of the fifth nerve was far more frequent on the *left* than on the right side. In 1857 I forwarded to the editors of the French translation of Mackenzie's *Treatise* (vol. ii. p. 763) a note containing all the literary references to cases of anæsthesia of the fifth nerve which I had collected up to that time. The result of the analysis of fifty-one cases is as follows: in five patients the fifth nerve was affected on both sides; in thirteen the right nerve only was affected; while thirty-three patients had anæsthesia of the *left* nerve.

[2] For this important fact we are indebted to the extended observations of Mr. Marson, at the Small-pox Hospital. Among 15,000 cases of small-pox, he had seen twenty-six instances of pustules on the eyeball; but they had invariably appeared on the conjunctiva, never on the cornea.

Ulcers of the Cornea.

Under the various heads of *Purulent*, '*Scrofulous*,' and '*Exanthematous Ophthalmia*,' and in the section on *Keratitis*, I have mentioned the more formidable kinds of ulceration to which the cornea is liable. The cases, however, are very numerous in which corneal ulcers are developed in a more isolated manner than in any of the above-mentioned diseases, being unattended with either purulent discharge from the conjunctiva, or general inflammation of the whole cornea.

Persons of all ages are liable to corneal ulceration. It is essentially a disease of debility, attacking those whose general power has been lowered by some exhausting illness, by bad or insufficient food, or some other depressing agency.

In persons of feeble reparative power, an ulcer, instead of healing up to the level of the healthy cornea, sometimes forms a slightly-depressed cicatrix. It is of course most important not to confound these two conditions, as is often done by those unaccustomed to the observation of eye-diseases. A recent ulcer, in which the destructive process is still going on, presents a sharply-cut, well-defined edge, with little, if any surrounding opacity, and the excavation itself, as regards transparency, offers but little contrast to the sound cornea. An ulcer which is healing has a bevilled margin, it is always more or less opaque throughout, and there is a cloudy halo surrounding it; and if the ulcer be large, vessels will be seen running to it from the edge of the cornea. A depressed cicatrix, on the contrary, has its edges smoothly rounded off, and its area is slightly opaque; there is little, if any, cloudy halo surrounding it, and seldom any plexus of vessels going to it from the corneal margin. In some cases, however, a depressed cicatrix is supplied by a small vessel or two, the remains of the plexus which once carried the material necessary for the healing of the ulcer which preceded it.

If the progress of an ulcer be not arrested, it may eventually perforate the whole thickness of the cornea. The aqueous humour then escapes, the iris falls forwards, so that the anterior chamber becomes altogether obliterated, a portion of iris—large or small, according to the size of the perforation—protrudes through the opening, towards which also the pupil is displaced. If the prolapsus iridis be very large, the whole area of the pupil may be annihilated.

In rare cases the ulceration stops short at the posterior elastic lamina of the cornea, which, in consequence of the pressure from behind, is thrust forwards as an almost transparent vesicle, filling up the cavity of the ulcer. The term *hernia corneæ* has been applied to this protrusion. It would at once be distinguished from a *prolapsus iridis* by the retention of the aqueous humour, and the consequent persistence of the anterior chamber.

There is one remarkable form of corneal ulceration of a singularly destructive and intractable character. In most of the cases the patients are persons in broken and unsound health. One eye only is usually attacked; the ulceration commencing at the edge of the cornea, rapidly forms a deep crescentic groove, which continues to deepen and extend itself, until it forms a considerable arc of a circle, and more or less completely isolates the central portion of the cornea, which is left standing up in high relief. Where this central portion eventually yields to the ulcerative process, sight is of course entirely lost. It is remarkable that frequently the posterior lamina of the cornea either remains unbroken, or is perforated to only a small extent. The form of ulceration is very similar to that accompanying gonorrhœal ophthalmia. In one very marked case there was very little pain or uneasiness, and the amount of redness in the conjunctiva and sclerotic was but trifling. Probably some change in the tissue of the vessels supplying the globe was the cause of this rapid and uncontrollable ulceration.

Treatment.—I have said that corneal ulcers are almost always a result of general debility, and therefore their cure is to be sought rather by improving the general power of the patient than by local application. The exception to this rule is formed by those cases in which the ulcer is very large, exhibiting a total want of reparative

action, and by those cases terminating in prolapse of the iris. In both of these instances, the local use of the nitrate of silver is often a very serviceable adjunct to the general treatment. It is most safely applied by touching the ulcer with a fine camel's-hair brush, moistened with distilled water, and rubbed for a few moments upon a clean stick of silver-nitrate. A solution of eserine-sulphate (gr. ij. to ℥j aq.) dropped into the eye sometimes effects considerable improvement.

The mischievous effects of lead-lotions, when applied to ulcers of the cornea, have been already alluded to (p. 35); and solutions of nitrate of silver, if used for too long a time, will also give rise to insoluble deposits, and consequent opacities.

While everything tending to improve the general health is to be resorted to in cases of ulceration, warm fomentations, either simple or of belladonna, and extract of opium, are commonly the best local application. The eye should be kept lightly covered; and if there be intolerance of light, or much pain in the eye, complete closure of the lids is indicated. This closure is especially necessary when either the iris has prolapsed, or a hernia corneæ has taken place.

I have already (p. 38) said how useless must be the attempt to push back a portion of iris protruding through a corneal ulcer. If the little nodule of iris soon becomes coated with an opaque layer of adhesive deposit, simple closure of the lids, and support of the general power by suitable diet and tonics, will suffice to cause the protruded iris to become adherent to the edge of the ulcer; after which, no further prolapse will occur. But if the protruding iris, instead of becoming coated with lymph, retains its natural colour and fibrous appearance, a touch with a fine point of nitrate of silver will often set up sufficient inflammation to cause adhesive deposit to take place. In like manner the deep excavated ulcer, which sometimes forms in very anæmic and weakly persons, and threatens to perforate the cornea, or to destroy it by rapidly spreading all around its margin, may be arrested, and a healing disposition given to it, by lightly passing the silver-nitrate over the whole excavation and edges of the ulcer.

Opacities of the Cornea.

It is of the utmost importance, as respects both prognosis and treatment, that the surgeon should make himself perfectly familiar with the varied appearances which corneal opacities assume. Without this knowledge, he will be constantly liable to deceive both himself and his patient, in promising the removal of opacities which are in their very nature permanent; or in pronouncing incurable, hazy conditions of the cornea, which, if promptly and skilfully treated, may be perfectly removed. To the latter class belong those cloudy opacities which I have described (p. 31) as over-spreading the cornea in the slighter forms of simple keratitis. The short period, a few days or weeks, during which the cloudiness had existed, the presence of a vascular zone in the sclerotic, and some degree of irritability of the eye, would all point out the cloudiness of the cornea as being due to simple inflammatory deposit within its substance, which, under suitable treatment, may be so entirely dispersed as to leave the cornea in all its original transparency. If, on the other hand, the same amount of general haziness were known to have existed for a long time—say a year or more—if there were a total absence of sclerotic redness, and if the eye had long ceased to be irritable, the surgeon would know that the opaque condition of the cornea was incurable, and he would no longer attempt the use of stimulating lotions and ointments, which could only arouse fresh irritation and increase the existing mischief.

The haziness which sometimes remains after a severe and obstinate attack of keratitis, presents an appearance not easy to describe, but which the experience of a few cases will readily enable the surgeon to recognise again. There is a total absence of unnatural vascularity about the eye, but the whole cornea is slightly shaded with a faint haziness, with intervening spaces of almost transparent tissue, through which the colour and texture of the iris and the form of the pupil can be recognised, although not in their natural distinctness. The dimness of sight in these

cases seems to be out of all proportion to the amount of opacity; and the patient can perhaps merely see black streaks when looking at a page of type.

The terms *nebula*, *albugo*, and *leucoma* have been applied to corneal opacities, according to their different degrees of density; the slighter forms being distinguished as *nebulæ; albugo* and *leucoma* signifying rather the white opacity of cicatrices. The edge of a *nebula* is gradually shaded off into the surrounding clear tissue; that of a cicatrix, at least one of old standing, is more or less abruptly defined. When a prolapse of the iris has taken place through a corneal ulcer, the leucoma which results is marked in the centre by a small blackish spot.

Treatment.—As regards the prognosis of nebulæ, their possible improvement mainly depends upon the age of the patient. In infancy, it is quite astonishing to see how the rapid interchange of material which is then going on, will diminish both the extent and the density of even large cicatrices. In an infant attacked with purulent ophthalmia, a cicatrix may at first be so large as to occupy the central third of the cornea, and yet, in after-life, a mere cloudy speck may remain opposite the centre of the pupil. At a later period of life, nebulæ, which form as the cicatrices of superficial ulcers, are more permanent; but around the denser part of the speck there is always a certain amount of cloudiness, which slowly disappears. The older the nebula, the more sharply defined is its margin.

Allusion has already been made to the permanent white deposit which occurs in corneal ulcers, when lotions containing lead have been employed. The metal is deposited in the state of carbonate, and forms a chalky-white layer on the ulcerated surface. Practice alone can enable the surgeon to recognise these old lead-deposits. They somewhat resemble a little patch of whitewash, their margin being sharply defined, and their surface often presenting minute cracks, through which the tissue of the cornea appears as dark lines. When the ulcer has been very superficial, and the metallic deposit lies just beneath the epithelium, the surgeon may sometimes succeed in scraping away the deposit; to do this, however, requires the utmost care and lightness of hand.

A very curious form of *calcareous deposit*—phosphate or carbonate of lime—between the cornea and its epithelium sometimes takes place without any previous inflammation. I believe this kind of deposit to be extremely rare, for, since I first noticed it in 1848,[1] I have seen only two other instances. From what I have already said concerning the nature of corneal opacities, the reader will perceive that when they are of old standing, and unconnected with any existing inflammation, local treatment can avail but little. Setting aside those exceptional cases I have enumerated as removable by operation, the partial disappearance of old nebulæ is due to that change of material which is constantly going on in the human body, and which is so much more active in infancy and childhood than after the period of growth has terminated. The lotions, the drops, the vapours, the ointments, which crowd the pages of the older ophthalmic works, if not actually hurtful, as being likely to set up fresh irritation, are either altogether inert or at best they serve to amuse the patient while time is slowly clearing the opaque tissues.

Injuries of the Cornea.

Abrasion.—The epithelium covering the anterior surface of the cornea is liable to be torn or scratched by coming in contact with any rough substance; or a little flap of the epithelium may be partially detached and doubled down. Those who have not seen these slight cases of injury to the epithelium cannot imagine how much pain they produce, especially in persons of a sensitive nervous system. The intimate relations of the epithelial cells and the terminal fibres of the fifth nerve renders this intelligible. A clean cut directly through the cornea often causes far less pain than an abrasion of the epithelium so minute as to be scarcely discernible.

[1] My case was first published in the Appendix to Bowman's *Lectures on the Anatomy of the Eye*, 1849; and a second time in my *Guide to the Practical Study of Diseases of the Eye*, 1855.

Within a short time after the epithelium has been injured, the sclerotic is often much injected, and a profuse flow of tears follows every attempt to separate the lids. The surgeon will best obtain a view of the part by placing the patient in a chair and standing behind him. As soon as the lids are widely separated, the pain almost ceases, and the surgeon must then carefully explore the whole surface of the cornea, while the patient moves the eye in various directions, so as to allow a bright light to fall on each portion in succession. A slight irregularity and roughness at one minute spot is often all that can be found to mark the position of the injury.

The *treatment* of these abrasions is very simple. A drop or two of olive-oil or castor-oil may be applied to the abraded surface, and then the lids are to be kept closed with a light pad of cotton-wool, and a bandage, or a compress dipped in a solution of extract of belladonna (℥j. ad ℥viii. aq.), for four-and-twenty hours. As soon as the epithelium is regenerated all irritation ceases, and the uniform polish of the cornea is restored.

Contusion of the cornea.—Blows on the cornea which do not cut or lacerate, but merely bruise, its tissue, vary greatly in their results, according to the violence of the blow, and the age and vigour of the patient. In the severer forms of contusion, softening and suppuration among the fibres of the cornea will probably occur, and the part will afterwards exhibit more or less haziness. But in very feeble or old persons, the whole cornea may become softened and infiltrated with pus, and in such cases the pain is often very severe.

At length the cornea gives way, the aqueous humour escapes, and the pain immediately subsides; but the whole or the greater part of the cornea becomes pulpy and disintegrated, and comes away in shreds, and ultimately the globe shrinks, or else a staphyloma is formed. The worst cases of this kind occur among paupers engaged in stone-breaking. During such work, a pair of gauze-wire goggles should always be worn.

Treatment.—Even a slight contusion, if it takes effect at the centre of the cornea, must be regarded as a serious accident, on account of the suppuration and consequent haziness that may possibly ensue. We must take care, therefore, not to reduce the patient by bleeding and mercury, since by so doing the vitality of the cornea is lowered, and softening and suppuration are more likely to take place. An eye which has received a blow on the cornea should be kept closed and defended from light, and poppy fomentation may be used, if any pain comes on. A narcotic may be required at bedtime; and the diet should not be reduced below that which is suited to the patient's ordinary condition.

The setting-in of suppuration, attended as it is with pain, would require an increased dose of the narcotic; and should the cornea give way, a tonic treatment, with a suitable proportion of stimulants, would become necessary, to limit the destruction of tissue, and afford material for repair. In such cases warm fomentations of belladonna and opium and the frequent instillation of eserine-sulphate prove very useful.

Incised and punctured wounds.—Although cuts of the cornea are usually produced by sharp-edged or pointed bodies, they also occasionally result from sudden blows inflicted with blunt ones; and a smart stroke with a stick will sometimes inflict on the cornea a cut as clean as if made with a knife. Wounds of this latter description, however, on account of the shock given to the whole eye, are usually much more serious than those made with sharp instruments. A wound involving one-half of the corneal margin, such for instance as is made in the operation of extraction, may become completely united within three or four days, without inflammation occurring in any other tissue of the eyeball, whilst a much smaller cut produced by a blow with a stick or stone will be followed by severe and long-continued inflammation, ending in complete disorganisation of the globe. Small sharp bodies, such as fragments of metal or glass, when driven with great force and rapidity against the cornea, frequently produce so small a wound, that a surgeon unaccustomed to see such cases may be apt to underrate the size of the foreign body which has

inflicted the injury; the elasticity of the corneal tissue causing the wound to contract as soon as the foreign body has passed through. When a case of this kind is seen immediately after the injury, the most careful scrutiny, with all the advantages of a good light, is often required to enable the surgeon to detect the wound. The whole surface of the iris, and especially the bottom of the anterior chamber, should be most carefully examined, in order to detect the lodgment of the penetrating body; and if the cornea be still transparent, and the aqueous humour retained, the pupil may be dilated with atropine, and the lens and deeper tissues explored with the ophthalmoscope. If any portion of the penetrating body protrude from the wound, it should be once extracted with a fine well-closing forceps, the lids being held apart with a spring speculum, and the globe steadied by nipping up a fold of the conjunctiva covering the sclerotic.

When the wound of the cornea is large, a portion of the iris is frequently forced through the wound. If such a case is seen very shortly after the accident, and before there has been time enough for the protruded iris to become united to the margins of the corneal wound by adhesive deposit, the portion of iris may sometimes be returned by careful pressure with a probe or small spatula. In such cases sulphate of eserine has been reported useful. The strong contraction of the pupil which it produces tends, it is believed, to draw in portions of iris which have escaped through a peripheral corneal wound. If, however, adhesion between the cornea and iris has already taken place, this reduction is impossible; and the surgeon must then content himself with maintaining the parts in perfect rest by keeping the lids closed.

Sometimes the protruded portion of iris gradually becomes distended with aqueous humour, and assumes a rounded pouch like form. This little pouch should be freely punctured, or a portion of it cut off with curved scissors, and the bandage applied as before.

The advice I have here given, as to returning the iris protruding through an incised wound of the cornea, may at first appear to be inconsistent with what I have before said, at p. 38; but the difference between the two cases consists in this—that when an ulcer has perforated the cornea, there is an actual loss of its substance, and if the iris protruding through such an aperture be pushed back, it will escape again and again. But in the case of an incised wound there is no loss of corneal tissue; and if the protruding iris be returned into the anterior chamber, the elasticity of the cornea will bring the edges of the wound into apposition, and keep them so until they have become united.

Punctured wounds of the cornea vary much in their character, accordingly as they are inflicted by means of pointed bodies of a large size, or by such small fragments as remain embedded among the fibres of the part. Wounds of the former class frequently involve other parts of the eye, and penetrate through the cornea into the iris or the lens. These complicated injuries cause either iritis or cataract, and will be spoken of in future chapters.

The simplest and by far the most common form of puncture of the cornea is that which happens when little fragments of metal or grit are forcibly projected against the eye, and remain sticking either in the epithelium or in the superficial layer of the cornea itself. Engineers, metal-turners, mill-stone dressers, stokers, are constantly liable to these injuries, and the surgeon should be able at once to remove the foreign body without inflicting in the attempt any farther injury on the cornea. Standing behind the patient, who should be seated opposite a window, the surgeon raises the upper lid by placing the tips of his first and second fingers against the edge of the tarsus, beneath the cilia, and then pressing the lid upwards and backwards without everting it; he then with these two fingers steadies the globe by gentle pressure just above the cornea, while the point of the ring-finger gently presses the globe at its inner side. In the other hand he holds a little spatula-shaped instrument (which for want of a better name I have called a 'spud'), the flat end of which he passes under the foreign body, and so tilts it out. The point of a cataract-needle is in a steady practised hand very suitable for extracting these little bodies. All the treatment

necessary after their removal consists in keeping the eye closed for a day or so with a compress and perhaps occasional fomentation.

If an elongated chip of metal strikes the eye obliquely, it sometimes wedges itself into the cornea at about the middle of its thickness, lying exposed to view, but so completely buried as to afford no hold to a forceps. The surgeon must with a cataract-knife or cutting-needle slit up the layer of corneal substance along the whole length of the foreign body, which can then be turned out without difficulty.

One of the injuries most difficult to treat is that inflicted by a sharp-pointed chip of metal just long enough to transfix the cornea, and to thrust its point into the anterior chamber, while the other extremity is so much embedded as to offer no hold for a forceps. If the surgeon attempts to dig out such a chip, he will almost certainly drive it farther in, until at last it slips wholly into the anterior chamber, and entangles itself among the fibres of the iris.

The removal of the foreign body will call for all the operator's skill and patience, and chloroform must be used if the patient be timid and unsteady. The lids being separated with the spring speculum, an assistant fixes the globe by nipping up with a forceps a fold of the conjunctiva at its lower part. The surgeon then, with a broad cutting-needle, makes an opening in the cornea close to its outer margin. The needle should be slowly withdrawn, without rotating it in the slightest degree, so that the aqueous humour may, as far as possible, be retained. Then a small spatula is to be passed in at the opening, and carried quickly and steadily across the anterior chamber, so as to interpose between the lens and the intruding point of the foreign body. The spatula is then to be pressed forward against the foreign body to keep it fixed, while with a cutting-needle held in the other hand, the surgeon slightly enlarges the wound on the anterior surface of the cornea. Still steadying the point of the foreign body with the spatula in the anterior chamber, he endeavours with a very fine and well-closing forceps, to grasp the extremity of the foreign body and draw it out of the wound.

It is preferable to support and fix the foreign body with the broad needle, rather than to withdraw this and replace it with the spatula, because should the aqueous humour escape before the end of the spatula is interposed between the point of the foreign body, which projects into the anterior chamber, there is risk of the lens being injured.

I have had occasion several times to perform this operation, which the minuteness of the foreign body, its close proximity to the transparent lens, and the necessity for limiting the extension of the external wound, combine to render one of the most difficult in ophthalmic surgery.

A foreign body, which passes quite through the cornea, may wound the lens and remain embedded in its substance, producing a traumatic cataract; or it may become fixed in the iris; or, having lost its momentum in traversing the cornea, it may fall down to the bottom of the anterior chamber. Under any of these conditions, if the surgeon sees the case immediately after the accident, while the cornea is still clear, and the iris and anterior chamber are not yet obscured by inflammatory effusions, he should endeavour at once to extract the foreign body. If it can be distinctly seen sticking in the lens, it will be right to make a section of the upper half of the cornea, and remove the lens, as in the ordinary operation for cataract. A chip of metal fixed in the iris may be removed with Assalini's spring-forceps,[1] or the cannula-forceps, introduced through a small corneal wound. It will be often found best to withdraw and excise the small piece of iris, in which the foreign body is entangled. And in the same manner foreign bodies of any kind, which are lying loose in the anterior chamber, may be seized and extracted.

The surgeon must not be deterred from attempting to remove these foreign bodies by the stories he will find in many of the older ophthalmic works, about the oxidation and solution, or encysting of metallic fragments. The lymph which is thrown out

[1] This instrument was invented by Assalini for seizing the iris in the operation for artificial pupil; *Richerche sulle pupille artificiali*, &c. Milano, 1811. For this purpose it has been superseded by the more delicate *cannula-forceps*.

around a metallic chip in the iris does indeed, for a time, encase it and hide it from view; but this is only the beginning of a tedious iritis, which will probably end in disorganisation of the eye, or, at least, produce obstruction of the pupil and loss of sight.[1]

Foreign bodies lying loose in the anterior chamber are to be removed in a similar way to that I have just recommended in the case of bodies fixed in the iris; the extent of the corneal incision being of course proportioned to the bulk of the body to be extracted.

This may perhaps be the most convenient place to notice those rare cases in which a living entozoon constitutes the foreign body in the anterior chamber.

The *Cysticercus telæ cellulosæ* has been repeatedly met with in this situation, as a rounded, semi-transparent, vesicular body, furnished with a long retractile neck, terminating in a head furnished with suckers and a circlet of hooks. If not removed, the animal eventually sets up inflammation of the iris and cornea, which ends in total loss of vision. A crescentic incision along the edge of the cornea allows of the escape of the animal along with the aqueous humour. Cases have been reported by many ophthalmic writers, among whom Mackenzie has given the fullest details, and has figured the animal both in its natural condition and magnified.[2]

All the operations on the cornea just described will be greatly facilitated by the use of the spring speculum, a forceps to fix the globe, and, in irritable and timid patients, by the administration of chloroform.

The *after treatment* of all the foregoing cases, in which an incision of the cornea may have been necessary for the removal of a penetrating body, mainly consists in keeping the eye perfectly at rest and protected from light, while the healing process is going on. For the first twenty-four hours at least, *both* eyes should be covered with a light bandage. After that period it may be sufficient to keep the wounded eye closed, and the length of time during which this closure should be maintained must depend upon the rapidity with which the wound heals, and the aqueous humour is re-secreted—circumstances varying according to the constitution of the patient, and the amount of violence inflicted on the eye by the accident and the subsequent manipulations of the surgeon. Patients should neither be kept low nor over-stimulated, but maintained as near as possible at their natural standard of vigour. Those of an irritable temperament will often require a narcotic for several nights after these operations; but if chloroform has been used, a narcotic should not be given while the system is still under the effects of the inhaled vapour.

[1] In a case I communicated to the *Dublin Journal of Medical Science* (n. s vol. vi. p. 210, 1848), a very minute scale of copper remained fixed in the iris for *eight years*, and, after causing repeated attacks of iritis, was at last thrust forwards against the cornea by the effused lymph; ulceration was set up, and the little fragment, projecting through the cornea, was seized and extracted.

[2] Mackenzie (*Practical Treatise*, &c., 4th edit. 1854) quotes a case of *cysticercus* in the anterior chamber, observed by Schott in 1830; another by Logan in 1833; and relates two cases of his own in 1848 and 1850, and two others in the practice of other surgeons. He also mentions a case reported by Appia, in which the cysticercus is *said* to have been seen within the substance of the cornea. In all these instances the *left* eye was affected, and Mackenzie remarks that 'the left has suffered much oftener than the right eye from the intrusion of *cysticerci*, either under the conjunctiva or into the interior of the organ.' Cases which have been reported subsequently to the publication of Mackenzie's work do not, however, bear out this statement. In the *Archiv für Ophthalmologie*, vol. i. p. 453, is a case of *cysticercus* in the *right* anterior chamber; and in the same journal, vol. iv. p. 113, is another, also in the right eye; Teale has reported a case occurring in the right eye; *Ophthalmic Hospital Reports*, vol. v. p. 320. When Mackenzie wrote, *cysticerci* had never been discovered in the *vitreous* chamber; but in the *Archiv* twenty cases have already been reported, nearly equally divided between the right and left eyes. (See a subsequent note on *cysticerci* on the retina and in the vitreous humour.)

CHAPTER V.

DISEASES OF THE SCLEROTIC.

Inflammation.

Scleritis; Sclerotitis; Rheumatic Ophthalmia.

The sclerotic is inflamed to a certain extent in all cases of keratitis and iritis, and exhibits that zone of red vessels close around the margin of the cornea which is so marked a symptom of both these diseases. A more extended inflammation of the sclerotic not uncommonly forms one of the complications of catarrhal ophthalmia.

But there is also a form of inflammation which is almost limited to the sclerotic, the conjunctiva being implicated only in a secondary degree, and this sclerotic inflammation may assume either the acute or the chronic form.

In the acute inflammation the whole of the sclerotic is intensely injected, the part assuming a peculiar pink tint, quite different from the more vermilion colour of conjunctival inflammation. In very severe cases the pink tint has a shade of violet, in consequence of the depth at which the vessels lie in the fibrous tissue. Intolerance of light and lacrymation are marked symptoms, and in and around the eyeball there is always considerable pain, which sometimes assumes the form of intense neuralgia throughout the ophthalmic division of the fifth nerve, extending even into the second and third divisions.

The attack is attended with general constitutional derangement; the tongue is coated, the appetite bad, and the urine often deposits large quantities of lithates.

Treatment.—The bowels must be first thoroughly cleared, and then narcotics given, in doses proportioned to the severity of the neuralgia and the former habits of the patient. Half a drachm, or a drachm, of tincture of hyoscyamus may be sufficient in some cases, while in others full doses of morphia will be requisite to insure sleep. In some patients quinine, in others iodide of potassium, is of great service; to those in whom a gouty diathesis is more marked, colchicum given in combination with an alkali will be far more beneficial. The patient's appetite is usually so bad that it requires management to induce him to take sufficient nourishment. Beef-tea, bread-and-milk, and various modifications of farinaceous food, are often more readily taken than solid meat. Sugar should be avoided, and beer as containing sugar, dry wine or diluted spirit being substituted, and of course only given in quantities demanded by the condition and previous habits of the patient. Local depletion by means of leeches seldom produces more than temporary benefit, and blisters only aggravate the neuralgia. Steaming the eyes over hot water is usually soothing, and preferable to fomentation, in consequence of the extreme irritability of the surface of the eye. A very effectual local application is chloroform, diluted with olive-oil according to the susceptibility of the skin, and applied on lint to the temple and forehead. The patient's room should be moderately shaded from light, and the eyes still farther protected, if necessary, by a suitable eye-shade, or tinted spectacles; but complete darkening of the room is unnecessary, and it has the great disadvantage of rendering the examination of the eyes by the surgeon intensely painful during the abrupt transition from darkness to light.

Chronic inflammation of the sclerotic occurs frequently, but by no means exclusively, in rheumatic subjects. Instead of involving the whole extent of the sclerotic at once, it commonly appears as a limited patch of redness, close to the cornea, after a time fading away, and then reappearing on some other portion of the white of the eye, but always keeping close to the corneal margin.

When this chronic inflammation of the sclerotic has gone on for a long time, it has a tendency to involve either the cornea or the iris. In the latter case the iritis is so insidious and so slightly marked as frequently to be overlooked; and it is not

until after the sclerotic redness has wholly disappeared that some dimness of vision induces the surgeon to make a careful examination of the pupil; when he will probably detect some small adhesions between the iris and the capsule of the lens, or a filmy opacity of the latter, dotted with minute patches of pigment.

It appears to be this form of obstinate sclerotic inflammation which Wilde[1] and others have described as 'inflammation of the ciliary body, ciliaritis.' No evidence, however, exists that this structure is specially the seat of inflammation; indeed, in most instances perhaps the subconjunctival areolar tissue and fascia are principally implicated, the sclerotic being only subordinately and very superficially involved. For such cases the term episcleritis used by some authorities is very appropriate. Episcleritis is most frequently seen in youths and young adults of feeble delicate constitution. It sometimes begins as a phlyctænula, which, instead of fading away as in ordinary phlyctænular ophthalmia, increases, extending the area of its base until it forms a low pink hummock-like swelling seated upon the sclerotic. Where the episcleral structures alone are implicated, or the sclerotic is only very superficially involved, upon the resolution of the inflammatory swelling no traces of the disorder remain; but where the sclerotic has been more deeply affected, it is not infrequently found thin and blue after the swelling disappears.

Treatment.—Chronic inflammation of the sclerotic is a very tedious affection, and one that is extremely liable to recur, if the patients are exposed to cold and damp, or fall into that dyspeptic condition which induces chronic rheumatism. Strict attention to diet, avoidance of sugar, and substances which form sugar in the system, a dry and temperate climate, will be the best means to prevent the sclerotic inflammation from becoming periodical in its return. Quinine is commonly the most effectual remedy, and small flying blisters to the temples are often valuable adjuncts. But if the patches of redness shift about from one side to the other, fading away at one part only to reappear at an opposite point of the globe, a vigilant watch should be kept upon the iris, lest it should be attacked with inflammation. If the pupil becomes sluggish and slightly irregular, a careful examination with concentrated light will probably reveal a very slight, barely perceptible, deposit of lymph fringing the pupillary margin. The sight will at the same time be more or less cloudy. In such a case recourse must be instantly had to atropine, and mercury or potassic iodide must be carefully given to check the iritis. The mouth must never be made at all tender, and the depressing influence of the mercury may be counteracted by a daily dose of bark, and a moderately nutritious diet. The bark should be continued in small doses for some weeks after the mercury has been left off.

Injuries of the Sclerotic.

Clean cuts of the sclerotic, inflicted with sharp bodies of various kinds, frequently involve the subjacent structures, the choroid and retina. If the latter be extensively divided, a greater or less quantity of the vitreous humour is almost sure to be lost. The laxity of the conjunctiva, however, often serves to limit the escape, as the tenacious fluid becomes entangled among the meshes of the subconjunctival areolar tissue.

The prognosis of wounds of the sclerotic depends upon their extent, the amount of vitreous humour which has been lost, and, above all, upon the fact whether or not the foreign body inflicting the wound has penetrated into the interior of the globe. The wound made by the entrance of a grain of shot is usually very small, as the elasticity of the sclerotic causes its fibres, after being separated by the shot, instantly to close up again, as soon as it had passed through them. When quite recent, a shot-wound in the sclerotic is hidden by a little patch of blood extravasated beneath the conjunctiva. The entrance of a grain of shot, or a fragment of metal, through the sclerotic into the vitreous chamber is almost certain to set up a slow inflammation of the whole globe, ending in loss of sight and atrophy of the organ.

[1] *Medical Times and Gazette*, n. s. vol. ix. p. 515, 1854.

Simple punctures and small cuts through the sclerotic, unattended with the retention of any foreign body, commonly unite very well, provided the eye be kept in perfect rest, and the reparative process be not interfered with, and checked by injudicious applications, or by general depletion and weakening of the patient's system. If extensive and gaping, and not complicated by the presence of a foreign body, the wound may be closed with a suture of the finest China silk passed through the episcleral tissues. It seems almost superfluous to insist upon the necessity for absolute repose for the wounded organ; and yet it is wonderful to see how the good sense of the surgeon, who would treat a fractured limb on the principle I have just mentioned, seems to desert him as soon as a wounded eye comes under his care.

Rupture of the sclerotic, with displacement of the lens.—A very remarkable injury sometimes happens to the sclerotic, consisting in a laceration extending completely through its substance, within a line or two of the corneal margin, while the conjunctiva remains unbroken, and the dislocated lens, slipping out through the rent in the sclerotic, becomes firmly wedged beneath the conjunctiva.

This rupture of the sclerotic always takes place on the side of the eye opposite to that which has received a severe blow with some blunt body; the fibres, being suddenly put on the stretch, give way at the point where they are the most bent. Hence it is that the seat of rupture is almost always either the upper or the inner part of the globe, the lower and the outer portions being comparatively exposed to violence, while the prominence of the eyebrow above, and of the nose internally, defends the upper and the inner portions.

Rupture of the sclerotic, with sub-conjunctival dislocation of the lens, is always attended with some injury to the iris. Either that portion adjacent to the sclerotic wound is drawn into it, the pupil remaining large, and displaced towards the margin of the cornea, or else the shock causes the ciliary attachment of the iris to give way, to a greater or less extent.

It sometimes even happens that the whole ciliary attachment gives way, and the entire iris is driven completely out of the globe, through the rent in the sclerotic, along with the aqueous humour, lens, and a portion of the vitreous body. This large escape of the contents of the globe only takes place, I believe, when the conjunctiva is also ruptured.[1]

When a recent case of ruptured globe is seen soon after the infliction of the injury, the parts are so obscured by blood that it is often impossible to form a correct estimate of the damage the globe has sustained. Detachment of the iris from its ciliary connection is always attended with bleeding, which may completely hide everything behind the cornea. The lens, too, if dislocated beneath the conjunctiva, is often enveloped in blood, so that its form cannot be precisely defined. Until the blood behind the cornea has been absorbed, it is impossible to ascertain whether the retina has retained its function; so that in every case the prognosis will be extremely doubtful.

Treatment.—If the detached iris is hanging out of the wound through a rent in the conjunctiva, it should be snipped off with scissors; but, inasmuch as the lens, if lying between the unbroken conjunctiva and the sclerotic, may be so obscured by effused blood as to be with difficulty recognised, it will be well to wait a few days until the blood has become absorbed, and then the division of the conjunctiva covering the displaced lens will allow of its easy removal; severe as this injury appears, recovery with very useful sight has been not infrequently observed.

Absolute rest of the eye is the one important point in the treatment of all cases of ruptured globe. For the first few days, both eyes should be kept closed, by means of strips of plaster or a light bandage. Afterwards, it will suffice to close the injured eye only; but this closure should be uninterruptedly maintained for a week or ten days.

[1] See two cases in which the lens and iris were driven out of the eye through the ruptured sclerotic, published in my *Practical Guide*, &c., 2nd edit. pp. 398–9. Also a case of sub-conjunctival dislocation of both lenses in the same person, p. 113, *note*.

The patient should not be kept on low diet, nor depleted in any way; least of all should he be brought under the action of mercury, as is too often done. Such treatment can only have the effect of lowering his reparative power, and so retarding the process of cure.

CHAPTER VI.

DISEASES OF THE IRIS.

Congenital Defects.

(*Iriaeremia; Coloboma; Misplaced pupil; Persistence of membrana pupillaris.*)

Congenital absence of iris (*irideremia*) always attracts the notice of those about the infant by the peculiar reddish glow which is reflected from the retina. The child seems to shrink from strong light, and there is a good deal of unsteadiness of the globes. The whole space behind the cornea presents one uniform red or orange tint, while the edge of the lens is marked out by a ring of golden light.

Such cases are peculiarly interesting to the physiologist, because they demonstrate that the iris is not an essential factor of accommodation.

Although the term *irideremia* would imply a total absence of iris, a slight rudiment of it is often found, forming a very narrow segment of a circle, skirting some portion of the edge of the cornea.

Considering that a certain number of infants affected with this rare malformation are yearly brought for an opinion to our public eye-hospitals, it is singular that an adult thus affected is so seldom met with. I can only remember to have seen one such case, a short notice of which I published several years ago.[1]

Coloboma.—This congenital malformation is the result of an arrest of development, whereby the fœtal eye-cleft is incompletely closed. The pupil, therefore, presents an elongated form, and extends down to the lower edge of the cornea.

A median fissure of the lower portion of the choroid and retina, and in some instances of the sheath of the optic nerve, accompanies *Coloboma iridis.* The iris and choroid being formed in the embryo from one vascular membrane curved upon itself, an arrest of development causes in both structures the same kind of defect along the median plane of the eyeball.

Coloboma iridis, however, is not always placed exactly on the median plane of the eye, but sometimes a little to the inner or outer side of it. It usually co-exists in both eyes, although not always in the same degree. Sometimes, instead of the pupil being prolonged down to the bottom of the cornea, an abortive attempt, as it were, to form a coloboma is evidenced by a puckered groove in the iris, extending downwards from the lower edge of the pupil. The actual size of the pupillary aperture in coloboma is not always quite so great as, on a superficial inspection, it appears to be; for the extreme edge of the aperture, when minutely examined, will sometimes be found to be fringed with a blackish-brown pigment; and this at first sight produces the effect of a larger area than really exists.

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An old prolapse of the iris through an ulcer, situated at the lower edge of the cornea, by drawing the pupil directly downwards, may produce an appearance a good deal like a *coloboma iridis.* The white cicatrix, however, in the former case, would always enable the careful surgeon to recognise the true character of the deformity.

Another abnormal condition of the pupils consist in their being placed near the

[1] *Guide to the Practical Study*, &c., 2nd edit. p. 400. Samuelson describes a case of *irideremia* in a man of forty-eight. Not only were the irides absent, but the closest scrutiny failed to detect any ciliary processes. His accommodation seems not to have been tested, but he asserted it to be perfect.—*British Med. Journal*, 1863, p. 495. In the *Monatsbl. für Augenheilk.*, 1866, *irideremia* is noticed as existing in a woman of forty-two. Her eldest child had the same defect. Hulme reports a case in a man aged twenty-two. He could read No. 6 of Jaeger's test-types.—*Med.-Chir. Trans.*, vol. xliv. France gives another case, a woman aged twenty-three.—*Guy's Hospital Reports*, vol. vii.

margin of the cornea, instead of opposite to its centre. Malposition of the lens appears frequently to accompany this eccentric position of the pupils.[1]

Persistence of the fœtal *membrana pupillaris* has been described as sometimes causing an obstruction in the pupil which might be mistaken for congenital cataract; but no practised observer could make such a mistake; for the *membrana pupillaris* is attached, not to the margin of the pupil, but to the anterior face of the iris, at a little distance beyond, where a more or less elevated ring of small tufts or nodules marks the lesser circle of the iris. Projecting from this part of the iris, I have occasionally seen slight vestiges of the pupillary membrane, in the form of little spurs or tags.

The persistence of any portion of this membrane, even in young persons, is a circumstance of extreme rarity. Dr. Cohn, in the *Klinische Monatsblätter für Augenheilkunde*, 1867 (p. 62), enters into an analysis of the cases published by different authors, and dismisses all of them except five as originating in a faulty diagnosis. He describes four cases from his own observation. I think there can be no doubt that, in most of the instances reported, old adhesions, the result of bygone iritis, have been mistaken for shreds of the membrana pupillaris.

[I believe these cases to be much less infrequent than was formerly supposed. —J. W. H.]

The following case appears to be worthy of record, as exhibiting a vestige of the pupillary membrane in a person of middle life.

In the summer of 1867, a lady, aged 30, consulted me for short-sightedness. The case was a very simple one, the myopia not in any high degree, and suitable glasses were all she required. I noticed a fine hair-like thread running obliquely across the pupil of the right eye, and at once recognised it as a vestige of pupillary membrane. It gave the patient no inconvenience, and indeed she could not be made aware of its existence under any illu-

Fig. 5.

mination I could apply. Fig. *a* represents the eye with the pupil in its natural state, and Fig. *b* after atropine. I had expected to find that, as the pupil dilated, while the two sides of the iris were held together by the little thread, the aperture would become irregular; but this was not the case to any appreciable extent. The iris, of a thoroughly healthy appearance, was of a rust-brown, and the filament was only a little paler in colour. At each end it had a bifid attachment, and looked like a portion of the proper fibrous tissue of the iris drawn out into a thread. Under the ophthalmoscope the media and fundus of the eye presented nothing unusual.[2]

In the *Albino* the iris partakes of the general want of coloured pigment which characterises the hair and skin. The layer of opaque pigment, termed *uvea*, is altogether wanting, and the structure of the iris presents a singular appearance, as if loosened by maceration. Whitish fibres are intermixed with others of a lilac colour, and through the whole attenuated iris the light reflected from the fundus of the eye transmits a reddish glow.

Albinism is frequently attended with defective vision, and always with great intolerance of light. In some cases, however, sight is very good, and extreme sensibility to light is the only thing complained of.

Functional Disorders.

Mydriasis; Myosis.

Mydriasis.—The pupil is dilated and nearly, or quite, motionless. It may be due to some defect in the retina, optic nerve, or its cerebral connections; or to some

[1] Figures of unusually extensive coloboma iridis, and of congenital malposition of the pupils, illustrate a paper of mine in the *Ophthalmic Hospital Reports* for 1858 (plate iv. figs. 2 and 3).

[2] This case was published in the *British Medical Journal*, March 20, 1869.

disturbance of the ciliary nerves inhibiting the fibres of the third distributed to the sphincter papillæ, or exciting the fibres of the fifth and sympatheticus distributed to the radial muscular fibres of the iris, or, lastly, to a direct injury of the iris, as where mydriasis follows a blow on the eye, in which case, not very infrequently, small lesions in the iris are apparent upon inspection under oblique illumination. Mydriasis is often associated with palsy of the ciliary and of the external ocular muscles in lesions of the third nerve. The treatment of mydriasis is that of its cause; locally, eserine may be used.

Myosis.—The pupil in advanced age is naturally small, and its dilatability much less than in early life. It is not to this condition, but to the contracted rigid state of pupil depending on disturbance of innervation, that the term *myosis* is properly applicable. Many cases of myosis, as pointed out by A. Robertson, are attributable to lesion of the cervical sympathetic inhibiting the fibres supplied from this to the dilator pupillæ. In such cases the pupil is small and does not respond to light, but within narrow limits it distinctly dilates and contracts in concert with efforts to accommodate.

Inflammation of the Iris—Iritis.

Before entering upon this very important subject, it will be desirable to say a few words about the appearances which the iris presents in a healthy state; for it is subject to many variations as to colour and mobility, which, if not rightly understood, may lead to serious errors of diagnosis; mere congenital peculiarities, or changes incident to age, being mistaken for signs of disease.

The iris presents every shade of bluish-grey and brown among the fair and the light-brown races of mankind; whilst among the negro races it is uniformly found of a dark brown, approaching to black. A parti-coloured iris is not very rare; a fourth, a third, or even half of its surface being brown, and the rest bluish-grey; or one iris may be wholly brown, and the other as entirely grey, each eye being perfectly normal in respect of sight. Light-brown irides are often marked with two or three isolated tufts of dark pigment, and these spots are frequently causes of alarm to those who are the subjects of them.

A very slight tremulous vibration of the whole iris attends every movement of the eyeball in some persons, who nevertheless enjoy good sight; but this tremulousness must be regarded as morbid, whenever it exists to any great extent. It is quite independent of the movements of the pupil, and is best seen when that aperture is contracted, as a larger extent of iris is then open to observation. As a decided morbid appearance, tremulousness of the iris is familiar to us in association with fluidity of the vitreous humour.

The pupil is not placed precisely in the centre of the iris, but a little nearer to the median plane of the body; so that the iris is rather narrower between the inner edge of the pupil and inner margin of the cornea than on the outer side of the pupil.

Any considerable deviation of the pupil from a circular form may be regarded as the result of disease; but the pupil may exhibit, especially in elderly persons, a slight irregularity of outline, without any disease having existed in the iris.

The mobility of the iris becomes less as age advances; and, in old people, we often find a small and almost fixed pupil, the sight remaining excellent. In examining the mobility of the pupils, each one should be tested separately, the other eye being closed; for such is the sympathy between the two organs, that when, in consequence of disease in the nervous apparatus, an eye has become quite insensible to light, its pupil, otherwise motionless, will contract whenever light is admitted to the sound eye.

The earliest mention of *iritis* occurs in a treatise by Schmidt, describing the inflammatory changes consequent upon cataract-operations as performed in his day.[1]

It is impossible to overrate the importance of inflammation of the iris; for when we consider that the visual function of the eye ceases if the small aperture of the

[1] *Ueber Nachstaar und Iritis nach Staaroperationen*, 1801.

pupil becomes closed, we at once appreciate the consequences of inflammatory effusion into its area.

The attention which has been bestowed upon iritis by ophthalmic writers has led many of them to indulge in minute and tedious subdivisions of the disease, and to distinguish them by complicated terms, which only serve to embarrass and confuse the practitioner.[1]

This passion for subtle refinements and nomenclature has been comparatively rare with English writers; and those whose practical experience has been the most extensive have made use of the simplest classification.

There are certain signs common to all cases of iritis, under whatever constitutional modifications it may be developed; such are, a well-marked sclerotic zone of injection; diminished mobility of the pupil, with more or less change in its form; a loss of the lustre and peculiar fibrous appearance of the iris; and a change in its colour.

Other signs mark the peculiar constitutional influence which has given rise to inflammatory action in the part. These will be noticed under the proper heads.

Traumatic Iritis.

Incised wounds of the iris are not the injuries which cause the greatest amount of inflammation in its tissue. On the contrary, clean cuts, even if very extensive, produce but little inflammatory reaction; while bruising, or continued pressure of the part, such as occurs in certain displacements of the lens, invariably gives rise to inflammation and adhesive deposits.

The wounds which are sometimes inflicted on the iris during the operation for extracting a cataract, or those which are made to form an artificial pupil, are rarely followed by iritis; and when, after a few days, the eye is examined, more or less blood may be found at the bottom of the anterior chamber, but the fibrous tissue of the iris will present almost its ordinary aspect.

The lodgment of a foreign body, however, even of the smallest size, always sets up iritis, which does not permanently cease until the foreign body has been removed. As foreign bodies, before reaching the iris, must have passed through the cornea, I have thought it best to treat of them in Chapter IV., under the section 'Injuries of the Cornea.'

A singular accident which sometimes befalls the iris may be mentioned in this place, although it is really attended with very little iritis, namely, detachment of the iris from the ciliary ligament. The organic connection between these two structures is so slight that a smart blow with a stick or a whip, the rebound of a twig, or the shock of a spent shot, is sufficient to sever them from each other; the extent of the separation varying in every possible degree, from a mere hair's-breadth to the complete detachment of the whole iris from its ciliary connection.

A very slight separation may almost escape notice. It appears as a small, black, elongated mark, close to the extreme edge of the cornea. In proportion to the extent of the separation will be the amount of deformity of the pupil; and when half of the circumference of the iris has been detached, the pupil will probably fall together and be wholly effaced.[2]

In all extensive cases of detachment, there is bleeding into the anterior chamber; sometimes to such an amount as at first to conceal the injury from view.

Unfortunately the surgeon can do very little in these cases. To replace the detached iris is utterly impossible, and vision must inevitably remain greatly impaired; but at least he can abstain from attempting to hasten the absorption of

[1] For remarkable instances of this mania for subdivisions and uncouth names, see the work of Von Ammon, *De Iritide*, 1836; and that of Rau, *Die Krankheiten und Bildungsfehler der Regenbogenhaut*, 1844.

[2] The appearances presented by separation of the iris from its ciliary attachment may be seen in most of the illustrated ophthalmic works. I may instance Mackenzie's *Treatise*, 4th edit. p. 396; Cooper, *On Wounds and Injuries of the Eye*, 1859, pp. 170, 173, 175; Lawson, *Injuries of the Eye, Orbit, and Eyelids*; 1867.

the effused blood by administering mercury. It may seem unnecessary to caution any one against such practice, but, in fact, the dogma that 'mercury induces absorption' is so firmly fixed in some minds, that instances are constantly occurring of patients being actually salivated as a means of promoting the absorption of blood which is filling the anterior chamber after rupture of the iris. The rational mode of treatment is to defend the eye from strong light, and to keep the general vigour of the patient up to a healthy point, and then nature will in due time completely absorb the blood, without any aid from drugs.

I have observed how readily the iris inflames when subjected to long-continued pressure. The most striking examples of this are seen, when, in consequence of a blow upon the eye, the lens has been loosened from its connections, and partially dislocated into the pupil. The traumatic iritis is still more severe, if there be, at the same time, an incised wound of the cornea. In that case, the aqueous humour drains away, and, in consequence, the iris becomes compressed between the cornea and the displaced lens. Inflammation of the iris soon sets in; vessels become visible in its tissue, and lymph is effused into the pupil, into which the lens is bulging. The cornea becomes hazy, and is traversed by vessels. The sclerotic and conjunctiva are deeply injected, and there is abundant secretion of tears. If the case be left to itself, or injudiciously treated, the pupil becomes eventually closed with effused lymph; or else the cornea softens and gives way. Meantime the deep tissues become disorganised, and, after protracted suffering, the patient finds the eye utterly useless.

The only way to anticipate all this mischief is to remove the displaced lens, which is acting like a foreign body. To do this requires much tact and care, and, in making the requisite opening in the cornea, the surgeon must endeavour to avoid isolating any considerable portion of corneal substance between his incision and the wound already existing in the cornea, lest the isolated portion should slough from interrupted nutritive supply. Sometimes the wound in the cornea is so placed that the surgeon, by enlarging it, can make an opening sufficient for his purpose. But if the wound be in the centre of the cornea, it is usually desirable to make the incision in a new portion, and as near the margin as possible. If the substance of the lens has been much broken by the original injury, the greater part of it will probably escape when pressure is applied; but if the lens be almost entire, it must be broken up as much as possible before any attempt at pressure is made. The use of the scoop will greatly facilitate the removal of the disintegrated lens, the pulpy substance escaping along the groove. In some cases the removal of a portion of iris will not only facilitate the removal of the lens with the scoop, but will prevent the occurrence or continuance of iritis.

The success of such an operation will depend upon its being performed soon after the accident, while the cornea is still clear, and before iritis and effusion of lymph have set in. If performed at a later period, there will be greater risk of vitreous humour being lost. In all cases the success of the operation, as regards restoration of sight, must be very doubtful; and if performed at a late period, relief of pain, and prevention of complete disorganisation of the globe, will probably be the best result that can be hoped for.

The treatment, after such an operation as I have just noticed, will be similar to that after an ordinary case of extraction of a cataract. Closure of both eyes for four or five days will be necessary, and the reparative powers of the patient must not be depressed by privation of due nourishment.

The surgeon must not deceive himself with the belief that in these cases of wound of cornea, with displaced lens, the administration of mercury can avert destructive inflammation. The efficacy of mercury in controlling the effusion of lymph in non-traumatic iritis, arises from the fact of there being, in that case, no foreign body—which a displaced lens really is—pressing against and irritating the iris. *Traumatic iritis*, set up by a displaced lens, is wholly beyond the powers of mercury, and its administration can only do harm, by lowering the patient's reparative power, and so unfitting him to recover from the operation, should removal of the lens be ultimately resorted to.

Rheumatic Iritis.

Rheumatic inflammation of the iris assumes either an *acute* or a *chronic* character. In the former case, the attack can usually be traced to exposure to cold wind or damp, when the body has been exhausted by fatigue or greatly overheated.

According to the nervous susceptibility of the patient, the onset of an attack of rheumatic iritis will be attended either by dull pain in and around the eyeball, or by acute neuralgia throughout the first division of the fifth nerve, extending even to the second and third divisions.

When the attack is severe, there is usually a good deal of intolerance of light, and lacrymation. The vascular zone is not well marked, on account of its being lost in the general injection of the whole sclerotic, which assumes the purplish tint I have described as characterising sclerotic inflammation.

Rheumatic iritis is almost always attended with some slight haziness of the cornea, and in this respect it differs remarkably from the syphilitic form, which, even in the most severe cases, often leaves the cornea perfectly clear. The morbid changes in the iris itself are sometimes so slightly marked as to escape an unpractised or a careless observer; so that it is not until the inflammation has subsided, and the cornea has become quite clear, that the still-existing impairment of sight causes a more careful scrutiny of the pupil to be made, and then inflammatory exudation into its area, and adhesion of its margin, are found to have taken place.

In the more acute form of rheumatic inflammation, the veins of the iris may be traced on various parts of its surface, as delicate red lines, diverging from the edge of the pupil to the periphery of the iris. I need hardly say that these fine vessels cannot be traced if there exists any considerable haziness of the cornea.

The pupil is contracted, more or less irregular, and as the inflammation goes on, this irregularity becomes more marked, in consequence of effusion of lymph[1] taking place between the edge of the pupil and the capsule of the lens. The insidious manner in which this fibrinous effusion occurs affords a marked contrast to the rapidity with which large masses of yellow or reddish-yellow lymph show themselves on the edge of the pupil in syphilitic iritis.

I have already noticed the neuralgia throughout the region supplied by the ophthalmic division of the fifth nerve, which attends an acute attack of rheumatic iritis. There is also very frequently considerable febrile disturbance, the urine being loaded with lithates.

The majority of cases do not present such acute symptoms as those just described, but pursue a more chronic course. The injection of the sclerotic being less general, the vascular zone around the cornea is better marked; there is little, if any, intolerance of light or lacrymation, and instead of severe neuralgia in the fifth nerve, there is only a dull aching pain in and around the eyeball.

But, whether the iritis be acute or chronic, there is still the same danger of effusion of lymph into the area of the pupil, and this danger is, as I have said, all the greater on account of the gradual and insidious manner in which the effusion takes place. To check this is the main object to be kept in view.

Treatment.—If the early stage of acute rheumatic iritis be attended with severe neuralgia, as is frequently the case, the treatment will be much the same as that which I have described in Chapter V., as suitable to acute inflammation of the sclerotic. In some patients iodide of potassium, in others colchicum, will be of most service; while some cases, characterised by visible enlargement of the veins of the

[1] In describing iritis, I shall frequently have occasion to speak of that exudation from its vessels which constitutes the most serious feature of the disease, by forming adhesions between the papillary margin and the capsule of the lens, or wholly blocking up the area of the pupil with opaque membrane. Whether this *exudatum* becomes itself converted into fibrous tissue, or whether it only influences the cells of the tissue among which it is effused, and causes new cells to be developed from those already existing, is a physiological question which can hardly be decided. I have used the term 'lymph' to describe this *exudatum*, because the word is familiar to all my readers, and is sanctioned by long usage.

iris, yield to turpentine. I have usually given the Chian turpentine in substance, as pills, four grains three times a day. The condition of the pupil must be carefully scrutinised from day to day; and if it be found irregular and angular, or if any brownish tags appear to be forming at its edge, mercury must at once be given. Two grains of calomel, with a third or half a grain of opium, may be taken night and morning; and should any tenderness of the gums begin, the quantity ought at once to be diminished, for if salivation be allowed to occur, the neuralgia is almost certain to return, and the mercury, which in small doses was so beneficial, begins at once to exert its depressing influence. In delicate subjects it is often very useful to give a dose of bark—Battley's liquor cinchonæ or quinine—in the middle of the day, during the time the mercury is being taken. The pupil is to be kept under the action of atropine.

It is almost impossible to lay down precise rules about diet. It should not be *low*—that is to say, innutritious—but light and easily digestible: soup, bread-and-milk, farinaceous food of various kinds, with or without a proportion of meat, according to the patient's digestive powers and previous habits. Stimulants should be given only in such quantities as may be necessary to sustain the circulating forces. Feeble and depressible persons may require a certain amount of dry wine, or diluted spirit, while those addicted to habitual indulgence may only eliminate the rheumatic poison which they have stored up in their blood, by abstinence from the alcohol and sugar they have so long abused.

Occasional steaming of the eye over hot water is the most soothing local application, and where neuralgia is present fomentation by means of compresses wetted with a watery solution of extract of belladonna and opium will often afford relief.

Leeches to the temples may occasionally be found useful at the onset of an acute attack where there is great congestion; but where neuralgia exists they commonly do harm, and they should never be applied to feeble and depressible subjects, or those liable to erysipelas. Blisters also have the disadvantage of exasperating neuralgia. They are, however, very serviceable in the chronic form which often succeeds the acute attack, and they certainly aid in removing that haziness of the cornea, which, if not promptly dispersed, is apt to become permanent.

Syphilitic Iritis.

Inflammation of the iris originating in syphilis is very frequently associated with other forms of secondary or tertiary disease, especially with eruptions on the skin. It is by far the most marked kind of iritis, and is characterised by a tendency to rapid and abundant inflammatory exudation on the iris, especially about the edge of the pupil, in which situation yellow, reddish-yellow, or nearly red nodules, gummata, sometimes attain to such a size as almost to close up the pupillary area.[1]

The cornea is either clear, or marked throughout its lower half by very minute dots, of a pale buff tint. These dots are as small as if pricked in with a point of a pin, and are so closely set together as to suggest to a superficial observer the idea of a faint cloudy haze. It often happens, however, that even these minute dots are wholly absent, and the cornea, during an acute attack of iritis, remains perfectly transparent.

There is always a vascular zone in the sclerotic, but not that generally diffused redness of the eyeball so frequently present in rheumatic iritis. Neither, as a rule, is there intolerance of light, which is one of the most marked symptoms of the rheumatic form.

Irides which have naturally a bluish tint, when attacked with syphilitic inflammation, appear more or less green. This is caused by the presence of yellow serum in the aqueous humour, the admixture of the yellow and blue forming, of course, a green tint. This fact may be demonstrated in some of those old cases in which

[1] In Sichel's *Iconographie* (pl. xiii. fig. 5) is a good representation of a mass of lymph, reddened with vessels, at the edge of the pupil.

chronic iritis has attacked an eye again and again, until sight has been lost, nearly all the tissues having undergone a morbid change. If in such a case the cornea be carefully punctured with a broad needle, and the fluid of the anterior chamber caught in a spoon, the application of heat will at once show the presence of albumen; and if the iris have been originally bluish, that colour will be restored as soon as the last drop of the yellow fluid has drained away from the anterior chamber.

When a patient has syphilitic iritis for the first time, it may attack both eyes together, or may be limited to one eye. When relapses occur, the inflammation usually affects the right and left eye alternately; and these attacks may come on without the patient having contracted any fresh primary disease.

Syphilitic iritis is so much modified by the condition of the patient, that the surgeon must take care not to form to himself any arbitrary idea of the appearances, or expect to find in every case the strongly-marked and unmistakable proofs afforded by large nodules of exudation around the pupil. In fact, iritis may exist to such an extent as to produce serious and permanent obstruction to the pupil, without any development of these nodules. In some cases the lymph is uniformly distributed around the margin of the pupil, which then assumes a thickened ring-like appearance, the rest of the iris exhibiting little, if any, deviation from its healthy aspect. The loss of its mobility, however, is always well marked, even in the slighter cases; and, indeed, the sluggishness or total immobility of the pupil, when exposed to light, is one of the most valuable diagnostic signs of iritis in its early stage.[1]

Occasionally the nodules of lymph, instead of appearing on the edge of the pupil, are situated on the greater circle of the iris, in the re-entering angle formed between it and the cornea. Such cases are comparatively rare.

In every case of iritis, the surgeon should most carefully examine the area of the pupil, to determine whether it be or be not overspread with lymph. This sometimes exists merely as a very thin film, which may escape detection, unless light be concentrated upon it by means of a lens of short focus. Such a film, however, if not speedily removed by proper treatment, will rapidly become thickened by fresh deposits, and, growing more and more opaque week by week, will eventually form a serious obstacle to the transmission of light.

The so-called 'closure of the pupil,' justly regarded as the most serious termination of unchecked iritis, is caused partly by the nodules of lymph which are thrown out upon the margin of the pupil, and unite it to the capsule of the lens (*synechia posterior*) and partly by exudation of the same inflammatory kind, which overspreads that portion of the capsule corresponding to the pupillary area. This exudation forms organised connections with the nodular deposits on the edge of the pupil, and eventually, by its contraction, draws the margin of the pupil together, and permanently blocks up its greatly diminished space with a tough, firm, and opaque membrane.[2]

Treatment.—From what has been said, it will be seen that the leading principle in the treatment of syphilitic iritis consists in procuring as quickly as possible the absorption of the exudation which has been effused in and around the pupil. To effect this, the most powerful agent is *mercury*. But when we consider the variety of constitution in patients attacked with syphilitic iritis, the impaired state of general health they frequently exhibit, in consequence of venereal taint, and the period at which the iritis sometimes occurs—namely, while they are only just recovering from the debilitating effects of salivation—it is evident that, in a treatise like the present, little more can be done than to indicate the outlines of treatment, and that the judgment and tact of the surgeon must be brought to the careful study of each individual case.

[1] I cannot point out any really good representation of iritis in its early stage. Indeed, it is hardly possible for an artist to convey a true notion of the delicate changes in form and colour which characterise the disease at that period.

[2] This form of obstruction is sometimes called 'spurious cataract,' but the term is manifestly improper, as the word 'cataract' should be strictly limited to opacity of the lens itself.

When a recent case of syphilitic iritis comes before us in a patient of good general power, we may at once order two grains of calomel, with a third or half a grain of opium, to be taken night and morning; first clearing the bowels, if necessary, by a rapidly-acting aperient. In private practice, where our patients are not necessarily exposed to the weather, the calomel may be given more frequently, but in smaller doses; a grain, for instance, every four hours, combined with just enough opium to prevent purging. By some, small and frequently repeated doses of grey powder are preferred to calomel, whilst others give the preference to mercurial inunction. Calomel vapour baths have the advantage of bringing the patient very gently under the mercurial influence; they very rarely salivate, and do not disorder the digestion.

The effect of the mercury must be judged of by the state of the eye, not by the soreness of the gums. Indeed, I look upon soreness of the mouth as a condition to be always avoided, if possible; never to be willingly produced, as is so often the case. As soon, therefore, as the gums begin to be at all affected, the calomel is to be given less frequently; the absorption of the exudation in the pupil being the test of the mercury having been effectual. The two-grain pills may be taken once instead of twice a day; the grain every four hours changed to the same quantity every twelve hours, and then taken at twice that interval of time.

A patient sometimes comes before us with recent iritis, which has come on while he was actually under the influence of mercury, given for venereal disease. What are we to do in such a case? Perhaps we shall find that the patient, while taking the mercury, has been kept on very low diet, deprived of all animal food, and restricted to 'slops.' In that case, the mere change to a better diet—animal food and other nutriment being given, with a moderate quantity of the stimulant to which he has been accustomed—will often effect a surprising change, and stop the further effusion of lymph; while iodide of potassium, with bark, or, if the patient be extremely depressed by the mercury, even quinine alone, will at once cause absorption of the lymph to begin.

Or a directly opposite state of things may exist. The patient may have sought relief from the depressing effects of too much mercury by indulging in stimulants, and in this way may have induced an irritable condition of the circulation, quite incompatible with a due interchange of material in the system. Restriction of stimulants within due bounds will be as essential in this case as their use had been in the case of the ill-nourished and anæmic patient.

If a patient has been attacked with syphilitic iritis while under the depressing influence of too much mercury, given for general syphilis, and it has been found necessary to suspend the use of the mercury until tonics and a change of diet should have improved his general health, we shall often find, that by resuming the mercury in *small* doses, while at the same time we continue the tonics, the iritis will yield, although it may have resisted the large doses which had been given under circumstances of over-stimulation or deficient nutrition.

Turpentine was recommended by Carmichael, as a substitute for mercury, in those cases to which I have alluded as unsuitable for the administration of the latter on account of general debility. I have, however, found more benefit from the use of iodide of potassium, or even of very small doses of mercury, combined with tonics and improved diet, as above described. I have sometimes found turpentine of service in cases of rheumatic iritis, characterised by hyperæmia of the iris and sclerotic, but unattended with much disposition to effusion of lymph.

Whether the iritis be treated with mercury or not, the pupil is to be kept dilated by means of atropine.

Syphilitic iritis has often a tendency to become *chronic*; each relapse being characterised by a slight sclerotic zone, a yellowness of the aqueous fluid, giving a greenish tint to blue irides, general dimness of sight, and a slight filmy deposit in the area of the pupil. This chronic form is chiefly found in patients who are the subjects of tertiary syphilis, and a carefully-regulated course of iron often affords the best means of treatment.

In describing iritis, I have hitherto spoken only of those changes which are visible under ordinary observation; but the ophthalmoscope has demonstrated to us, what we formerly could only guess at, namely, that in iritis the deeper structures of the eye are often seriously affected.

To attempt to examine the fundus oculi during an acute attack of iritis, would be not only useless, but injurious; for the exudation deposited in the pupil, and perhaps in the vitreous humour also, would prevent any clear view of the parts behind; while the glare of light would be almost certain to increase the already existing hyperæmia of the organ. We often, however, have the opportunity of examining the fundus after all inflammation has passed away, leaving the cornea, lens, and vitreous humour transparent. We can then fully appreciate the close connection between syphilitic inflammation of the iris and of the choroid, and understand why it is, that in cases of so-called 'iritis,' the dimness of vision is often out of all proportion to the changes in and about the iris.

One of the sequelæ of iritis (I use the word 'iritis' in its more extended sense) is a cloudy condition of the vitreous humour, in which filaments and shreds, varying in shape and size, float freely in every direction. These bodies, although really whitish, of course appear black, or nearly so, when seen against the illuminated fundus oculi. They appear to be inflammatory deposits, intermixed in some instances with broken-up hyaloid membrane.

Large, irregular, white patches are scattered over the fundus, in some cases involving the greater part of its surface. Patches and dots of black pigment are frequently seen scattered over and among these opaque portions. (Plate I. fig. 3.)

Hence, it appears that syphilitic inflammation, when it attacks the eye, may exhibit its chief phenomena in the iris, involving the deep structures only to a very slight extent; or both may be equally affected; or lastly, the deep structures may suffer in such a degree as almost to become useless, while the iris shows little, if any, sign of inflammation, and the patient is hardly aware of the eye being the subject of disease, until vision is found to be almost lost.

Syphilitic Iritis in Infants.

Iritis is one of the rarest forms in which hereditary syphilis manifests itself during infancy. The careful researches of Mr. Hutchinson,[1] however, have shown that it is not quite so rare as has been supposed; and it probably often escapes notice on account, as he observes, of the very small amount of local symptoms which it causes, coupled with the fact that infants usually keep their eyes shut. During ten years I saw but five or six cases of syphilitic iritis in infants, among the many thousands of patients whom I treated at the Moorfields Hospital. Some of these infants presented the stunted and unhealthy aspect which usually accompanies inherited syphilis; but two, whose cases I have elsewhere reported in full,[2] were well-grown children.

One of the most striking peculiarities of iritis in infants is the very slight development of a sclerotic zone, that unfailing sign of iritis in the adult. Indeed, in some of the cases I have seen, sclerotic redness could hardly be said to exist.

The infant at the age of from two to ten months is attacked with copper-coloured eruption; perhaps also with mucous tubercles about the genitals, aphthæ in the mouth, and 'snuffles.' The eyelashes fall off, and sometimes the nails also are partially detached. In some cases the skin presents a peculiar dusky tint, and is wrinkled and scurfy.

The lymph does not assume the form of solid tubercular masses on the edge of the pupil, as in the adult, but either fills the area of the pupil, as a pale yellow semi-fluid mass, or sinks down to the bottom of the anterior chamber, like ordinary *hypo-*

[1] The result of Mr. Hutchinson's observations is given in *A Clinical Memoir on certain Diseases of the Eye and Ear, consequent on Inherited Syphilis, &c.*, 1863.

[2] *A Guide to the Practical Study of Diseases of the Eye*, 2nd edit. 1859, p. 149.

pyon. In one of the cases I saw, the lower half of the iris was completely hidden by a nodular mass of lymph, of a pale buff tint, which came into contact with the cornea, and completely filled the anterior chamber as high up as the middle of the pupil.[1] In another case, the effused lymph—for such it seemed to be—was scattered all over the lower half of the iris in the form of little, greyish-white, semi-transparent granules, like grains of coarse sand. The pupil was fringed with the same kind of deposit.

Treatment.—Before speaking of any special medicines for infants affected with syphilitic iritis, I would remark on the absolute necessity for their being suckled, and not brought up by hand. The milk of a healthy wet nurse would of course be infinitely preferable to that of an infected mother; but in the lower classes of society, among whom this disease is almost exclusively met with, the services of a wet-nurse can hardly be obtained.

Mercury should at once be given; and as hydr. c. cretâ is very uncertain in its chemical composition, I always make use of calomel, giving from a quarter of a grain to half a grain night and morning. The effect of the medicine must be carefully watched from day to day, and as soon as the lymph begins to disappear from the eye, and the cutaneous eruption to fade, the dose may be gradually diminished; but it will often be necessary for the mercurial treatment to be continued, in a modified form, for several weeks. Weakly infants will be much benefited by taking five minims of Battley's liquor of cinchonæ twice a-day in a little milk. Provided the child sucks and digests well, the mercury does unmixed good, and, by counteracting the venereal poison, not only frees the skin from the specific eruption, but imparts to it a healthy hue, instead of the peculiar dusky colour which was originally so evident.

A few drops of a solution of atropine, containing two grains of the sulphate to an ounce of water, may be put into the eye once a day. So powerful a poison cannot safely be used without limit to young infants, even in its diluted form.

Scrofulous Iritis.

Most of the patients in whom I have observed this form of iritis have been between five and fifteen years of age, and all have shown signs of a scrofulous constitution.

The iritis presented a resemblance to the syphilitic inflammation of adults, in respect of the abundant exudation which took place on the iris, and in the anterior chamber; but in the severer cases of the scrofulous form there was a still greater disposition to enlargement of the veins of the iris, and infiltration of its whole tissue, than is usually met with in syphilitic cases. In scrofulous iritis the large masses of yellow deposit are not so frequently limited to the margin of the pupil, but often appear midway between the pupil and the outer circle of the iris, or at the latter point, just in the angle between the iris and the cornea. Slight bleeding not unfrequently takes place into the anterior chamber, from giving way of the distended veins of the iris.

The cornea usually remains clear, but it sometimes presents a slight degree of mottled opacity, especially towards the lower part.

Treatment.—In the treatment of scrofulous iritis, as in all scrofulous affections, the diet and general mode of life deserve the utmost attention. Abundance—not excess—of animal food; warm clothing, pure air—sea-air, if attainable—are all important adjuncts to the medical treatment. Cod-liver oil is often of great service, and may be taken in combination with the other remedies. The bowels are usually irregular, and the appetite bad; and a mild aperient will be occasionally required; but care should be taken to avoid drastic purgatives, such as scammony and jalap.

When there is abundant inflammatory exudation into the anterior chamber, without much enlargement of the veins of the iris, or development of a sclerotic

[1] *A Guide to the Practical Study of Diseases of the Eye*, 2nd edit. 1859, p. 149, fig. a.

zone, half a grain or a grain of calomel at night, and two or three grains of quinine, or ten or twelve minims of liquor cinchonæ, taken an hour or so after a meal, will often produce a rapid absorption of the effused fluid. Where the exudation assumes the solid form, infiltrating a considerable portion of the iris, or appearing at its inner or outer circles as large yellow nodules, reddened with vessels, the iodide of iron is often useful, both in promoting the absorption of the deposit, and in diminishing the vascularity of the iris itself.

All stimulating lotions must be avoided; nor, indeed, except atropine, is any local application of service.

A form of iritis may be not very infrequently observed in youths and young adults, usually of a scrofulous diathesis, which differs from that just described by the little prominence of the characteristic iritic symptoms. Gummata are inconspicuous or absent, and a slight cloudiness of the pupil and a few small synechiæ, with a slight change in the colour and lustre of the iris, and sluggishness of the pupil, are the principal evidences of inflammation apparent in the iris itself. That which is eminently characteristic of this form of iritis is the occurrence on the back of the cornea of numerous opaque dots, most of them so minute as to require a magnifier for their distinct recognition. Of these the larger may be observed to change their position; they gravitate slowly towards that part of the cornea which happens to be most dependent. They are, therefore, probably fibrinous coagula. The smaller dots are fixed, and these have been shown, in some instances at least, to be patches of proliferating and degenerating epithelium.

This form of iritis is the aquo-capsulitis of the older surgeons, the serous iritis of modern continental authors. It is an insidious and usually very chronic disorder. Topically atropine, internally cod-liver oil, and ferric iodide, corrosive sublimate in small doses, and potassic iodide, will be found the most useful remedies.

Gonorrhœal and Arthritic Iritis.

I have never been able to trace an attack of iritis as a result of simple gonorrhœa; although, of course, it may often happen that a patient is attacked with ordinary rheumatic iritis within a short period of his having had urethral discharge. Gonorrhœa is unfortunately so common, that were there any definite form of iritis dependent upon it, so marked a sequela of the discharge would be constantly brought under our notice.

Neither have I seen cases of iritis which I could refer to gout. The descriptions of 'arthritic iritis' one meets with in books are chiefly taken from German writers, especially Beer and his contemporaries, whose account of the disease, which they term *gouty* inflammation, more nearly answers to that of chronic glaucoma. The ash-coloured ring in the sclerotic, immediately surrounding the cornea, described by German writers as the *arthritic* ring or circle, and regarded by them as diagnostic of arthritic iritis, is not peculiar to any special form of inflammation. Its presence merely depends upon the anatomical arrangement of the adjacent portions of the sclerotic and cornea. When these two structures are united obliquely, so that a considerable extent of the sclerotic is overlapped by the cornea, the vessels of the former do not appear to advance so near to the iris as in other cases; and hence a narrow ring, of a paler tint, is interposed between the iris and the dense plexus of vessels forming the sclerotic zone.

[That, exceptionally, iritis is actually a sequel of gonorrhœa, such cases as the following afford very strong persumption. A gentleman in a public office, æt. 24, in sound health, caught a clap. He had never had rheumatism, and his family, several members of which were well known to me, appeared remarkably free from any gouty and rheumatic tendency. The local symptoms of the gonorrhœa were very acute. About the end of the second week he was attacked with synovitis in both knees and ankles, which proved very intractable, and left these joints weak and stiff long after the inflammatory symptoms had disappeared. Within a very

few days of the accession of the synovitis, iritis developed itself in both eyes. The symptoms were very acute: the gummata in the iris were very large and conspicuous, the congestion was considerable, and the pain in and around the eyeball was severe. In spite of an energetic treatment, the iritis proved very obstinate; it subsided slowly and left large synechiæ. Nearly four years later he again acquired gonorrhœa, which was very quickly followed by another attack of synovitis in the same joints, and very slowly after the accession of this he again had a double iritis, the symptoms and course of which resembled those of the first attack. In the interval his health had been good, and he had remained free from joint and eye inflammation. There was not the slightest ground to suspect syphilis. I have seen several similar cases, in most of which there was also gonorrhœal rheumatism, but in some this joint complication was absent. In all the gummata in the iris and the congestion were considerable.—J. W. H.]

Use of Atropine in Iritis.

In a former edition of this work I spoke unfavourably of the employment of atropine during the acute stage of iritis. Subsequent experience has led me to modify my opinion on this subject. Of course the action of atropine will be most evident in those cases where the inflammation is quite recent, and where consequently the tissue of the iris is not, as yet, much thickened by congestion of its vessels, nor infiltrated with lymph. Where abundant effusion of the latter has taken place around the margin, and within the area of the pupil, atropine may not produce any change visible to the observer; but when this stage of effusion has not yet arrived, or when, at a later period, it is passing off, persistent dilatation of the pupil may be induced by atropine, and such dilatation will have the effect of hindering the formation of adhesions between the iris and the capsule, or of causing such adhesions, if already existing, to give way. In all cases of iritis, therefore, a solution of atropine should be dropped upon the eye night and morning. Where the inflammation is recent, and atropine is used in anticipation of lymphatic effusion, rather than to counteract the solidification of deposits already formed, a solution of two grains of the sulphate of atropia, in an ounce of distilled water, may be employed; but in the more acute cases a solution of double that strength will be required.

Not contented with insisting on the utility of atropine as an adjunct to mercury in the treatment of iritis, some recent writers have even gone so far as to recommend that the disease should be treated by the use of atropine alone. More dangerous trifling I cannot conceive. No doubt cases of iritis occur in which the tendency to effusion of lymph can hardly be said to exist at all, and such exceptional cases may possibly get well without any mercury being given. But we are not warranted in assuming that a case of iritis which begins in a mild form is going to maintain that character throughout, and it is our duty to employ that agent which above all others has the property of counteracting the effusion of lymph, and the consequent loss of transparency in parts essential to vision. And what rational cause is there for this anxiety to avoid the employment of mercury? Used ignorantly, as we too often see it used, mercury is a fearful curse to mankind; but, moderately and judiciously used, it is one of our greatest blessings. If patients with iritis are to be so impregnated with mercury that profuse salivation and all the other miseries of mercurial poisoning are induced, they may well pause before submitting to a remedy almost as bad as their disease. But this kind of mercurial treatment is never necessary. Those cases of iritis commonly do best where the mouth has not even been made tender, and therefore there is no real necessity for the attempts that are being constantly made to treat iritis without mercury. We are often told that iritis will get well without it—and so no doubt it will, in a certain sense, get well without any treatment at all. But the eye is in one respect a wholly exceptional organ. Once let its transparent tissues become opaque, and then, although the eye may in a certain sense have recovered from an inflammatory attack, the function of the organ is impaired or destroyed. The treatment of iritis consists in speedily prevent-

ing the formation of patches or films of inflammatory deposit in the transparent media of the eye, and if mercury has the invaluable property of doing this, it seems criminal in the surgeon to neglect the use of it.[1]

It is a curious fact that in certain persons the application of sulphate of atropia to the conjunctiva will set up all the symptoms of acute catarrhal ophthalmia complicated exceptionally by acute eczema of the eyelids and cheek. I do not speak of solutions to which a few drops of acid or of alcohol have been added. Such additions, I know, are sometimes made; but they are as unnecessary as they are irritating, for well-made sulphate of atropia is quite soluble in distilled water. The first instance of my meeting with this effect of atropine occurred in a hospital in-patient who used drops from the same solution that was being dispensed at the time to many hundreds of others, none of whom experienced any similar inconvenience. As soon as the drops were discontinued, the conjunctival inflammation rapidly subsided, and it was again excited by a reapplication of the atropine. I have since met with another case, in which great irritation, both of the eye and eyelids, followed the use of drops which I myself applied and knew to be perfectly neutral. In such cases sulphate of duboisia may be advantageously substituted for atropine.

Sequelæ of Iritis.

Besides the changes already mentioned as resulting from iritis, such as obstruction, or closure of the pupil, the inflammation is sometimes followed by degeneration of structure, which more or less involves the whole tissue of the iris.

Chronic iritis, for instance, in a cachectic subject, especially if the disease has been allowed to run on unchecked, is apt to induce a permanent thickening of the iris, all appearance of its normal fibrous tissue being lost, and the veins of the part becoming enlarged and irregularly dilated.

On the other hand, the constant pressure of a calcified lens, which has become thrust forward against the iris, will sometimes induce such wasting of its tissue, that the uvea wholly disappears, and the thin web of iris which remains allows the chalky-white lens to be distinctly seen through it.

Another consequence of iritis is the distension of the iris into *pouches*, which are formed in the following way. An attack of syphilitic iritis, left to itself, or badly treated, causes the whole margin of the iris to adhere to the capsule of the lens; the pupillary area being, at the same time, very small, and filled up with opaque deposit. All communication between the anterior and the posterior aqueous chamber is cut off; and the aqueous fluid secreted in the latter cavity, not being able to pass through the pupil into the anterior chamber, accumulates behind the iris, and gradually distends and presses it forwards; the pupillary margin meantime being prevented from advancing with the rest of the iris in consequence of its union with the capsule.

If the uveal surface, except just at the edge of the pupil, be free from adhesion, the whole anterior surface of the iris forms one convex mass, with a deep depression at its centre, in the position of the closed pupil; but if the uvea be here and there adherent to the capsule of the lens, the iris at those spots remains retracted, like the pupil, while intervening portions of iris are thrown into a series of pouches which may almost, or quite, touch the cornea. These pouched portions of iris lose their fibrous appearance, and have a dark slaty tint.

Vision, in such cases, is reduced to mere perception of light; but, provided the retina be sound, excellent sight can often be restored by means of a carefully-planned and skilfully-executed artificial pupil.

In cases of long-continued iritis, combined with disease of the choroid, and of the anterior portion of the sclerotic, the iris not only becomes united to the capsule, and bulges forwards in the manner just described, but the fluid secreted in the

[1] Remarks on the use of atropine in iritis almost identical with the above were to have been added to the third edition of my *Guide to the Study of Diseases of the Eye*, 1866, but by inadvertence they were not sent to the printer.

posterior aqueous chamber, continuing to accumulate, exerts pressure on the anterior portion of the sclerotic, and stretches its weakened tissue. This gradually yields, and forms a *staphyloma scleroticæ*, a tense bluish-black prominence, streaked with the widely-separated whitish lines of the sclerotic fibres. At first, while the prominence is small, it is usually situated at the upper part of the globe, just behind the cornea; but the distension may go on until the whole of the sclerotic, between the line of insertion of the recti muscles and the margin of the cornea, forms one bulging lead-coloured swelling. *Staphyloma scleroticæ* is always a sign of the deeper tissues of the eye having suffered from disease, and, if developed to any considerable extent, would contra-indicate operations for artificial pupil or cataract.

Cysts of the iris.—In very rare cases a punctured wound of the iris, near its ciliary attachment, has been followed by a cyst-like expansion of its substance, in consequence, apparently, of the fluid of the posterior aqueous chamber finding its way between the uvea and the fibrous tissue of the iris.

These cysts present a dark slaty tint, which nearly approaches to black when their walls become very thin. The treatment of these cases is often extremely troublesome, on account of the readiness with which the expanded iris-tissue reunites after being lacerated. When the lens is *in situ*, and transparent, the difficulty is greatly increased.[1]

[Cysts in the iris are of two kinds: (*a*) Watery cysts, hygromata, consisting of an extremely delicate membrane lined by a single layer of pavement epithelium; (*b*) Thicker walled cysts enclosing an opaque mass of scaly epithelium and epithelial débris. The close similarity of their contents to those of ordinary subcutaneous sebaceous wens places this kind of iritic cyst in the same category with these.

Both kinds of iritic cyst are in the great majority of instances of traumatic origin. Most probably originate in the iris, but some seem to originate in the ciliary region, and from this to invade the iris. Thorough excision of the cyst, including the iris with which it is connected, can alone be recommended. If any part be left behind, experience shows that the cyst soon forms again. Mere laceration, however free, is quite useless to procure a permanent result.—J. W. H.]

Operations on the Iris for Artificial Pupil.

Many of the diseases and injuries affecting the iris and cornea described in the foregoing chapters, produce complete closure of the pupil, while others either cause it to become displaced from its natural position, or leave it more or less completely hidden behind a dense corneal opacity.

All operations for the relief of such obstructions or mal-positions of the pupil may be suitably described in this place; while the operation on the iris, for the cure of *glaucoma*, must be deferred until that disease has been considered.

The term *Artificial Pupil* must be understood to include not only the formation of a new aperture in the iris, when the portion forming the natural pupil has prolapsed through a breach in the cornea, but also the reopening or the enlargement of the natural pupil when obstructed by inflammatory deposit; or the displacement, towards a transparent part of the cornea, of a pupil which has become overshadowed and hidden behind a dense corneal opacity.

Before attempting any form of operation for artificial pupil, the surgeon must make himself thoroughly acquainted with the history of the case, and especially ascertain for himself the following conditions:

First, whether the eye perceives light. Mere obliteration of pupil will not deprive the eye of this power, provided the retina be sound; for we know, by personal experiment, that even the thickness of our closed lids does not prevent our noticing the shadow of a hand passing between our eye and the window.

[1] See a case reported at length in my *Guide to the Study of Diseases of the Eye*, 2nd edit. 1859, p. 408.

Secondly, the presence or absence of the lens must, as far as possible, be ascertained, and, if present, whether it is transparent or opaque.

Thirdly, the cornea must be carefully examined, as to its degree of transparency.

Fourthly, the state of the iris itself must be noticed. The existence of chronic iritis would induce the surgeon to defer the operation until the inflammation had ceased. A thickened iris, in which all trace of its peculiar fibrous structure is lost, is specially unfitted for an operation, as it breaks away under the slightest traction, and, if cut, the wound does not gape, so as to form a permanent aperture.

As a rule, it is not desirable to operate for artificial pupil when the other eye is perfect.

The principle, not to inflict unnecessary injury on the parts operated upon, which holds good of every surgical operation, applies with peculiar force to that for an artificial pupil; for often the portion of transparent cornea is very small, and a needlessly large cicatrix may seriously diminish the patient's field of vision.

Generally speaking, a small artificial pupil is more useful than a large one; that is to say, if it can be made in such a position that all the cornea in front of it is transparent. Sometimes, however, the pupil has to be drawn from behind an opaque corneal cicatrix; and in that case it is only by making a large aperture that a sufficient portion of it can be rendered available.

Inasmuch as the natural pupil is placed nearly in the centre of the iris, it would follow that a similar position must be the most suitable for an artificial aperture. Various considerations, however, may induce the surgeon to select a more peripheral situation; but he should always strive to approach the centre of the iris, as far as circumstances will allow.

Peculiar care is required in the examination of those cases, frequently brought under our notice, in which the greater part of the cornea appears converted into a more or less prominent, densely opaque, white cicatrix, after severe purulent or gonorrhœal ophthalmia. The patient may have good perception of light, and there may be an appearance of a narrow strip of semi-transparent cornea adjacent to the sclerotic, suggesting the possibility of an artificial pupil being made. And yet the appearance of true corneal tissue may be altogether deceptive.

When the whole cornea has been destroyed by ulceration, as in severe purulent ophthalmia of infants, or the gonorrhœal ophthalmia of adults, the iris is for a time laid bare; but very soon exudation takes place on its surface, while the iris, yielding to the pressure behind, gradually forms the prominence known as *staphyloma*. The greater part of this fibrinous coating of the iris eventually becomes white and opaque, and traversed by ramifying vessels; but the marginal portion of the iris is covered by a semi-transparent tissue, united, perhaps, to a very narrow ring of true cornea, just that portion immediately connected with the sclerotic. No space, however, exists between this semi-transparent, cornea-like tissue, and the fibres of the iris; and any attempt, therefore, to make an artificial pupil in this situation would only end in disappointment.

The different modes of making an artificial pupil may be classed under four heads: *laceration*, *incision*, *excision*, and *ligature*.

1. *Laceration.*—This consists in tearing away a certain portion of the iris from its ciliary attachment. It is scarcely applicable to other cases than where there is only a very limited marginal portion of transparent cornea, the rest being opaque. Here, with a slender forceps introduced through an incision in the opaque part of the cornea, the iris corresponding to the transparent part may be seized, torn from its peripheral attachment, and cut off.

2. *Incision.*—This is the oldest form of operation for artificial pupil, being that employed by Cheselden in a case commonly spoken of as the first in which an artificial pupil was made. The operation is founded on the elasticity of the fibres of the iris, which causes them to retract when cut across, so as to leave an aperture for the transmission of light to the retina. Hence it will be seen that the operation is likely to succeed in proportion to the state of tension and retractile power of the iris, and will be inadmissible in those cases of closure of the pupil resulting from chronic iritis,

or any other disease of the iris which has caused softening and degeneration of its tissue. The operation by incision would also be contra-indicated if the lens were present, as injury to it must almost inevitably follow the penetration of the iris by a cutting instrument.

The operation, therefore, is much restricted in its application, and is almost confined to those cases in which, after extraction of a cataract, there has been prolapsus iridis to such an extent as wholly to obliterate the pupil, the fibres of the iris remaining on the stretch in consequence of so large a portion becoming healed into, and confounded with the corneal cicatrix.

The incision is made either with a cutting-needle or a fine narrow knife, or else with scissors. The needle or knife is passed into the anterior chamber close to the edge of the cornea, and when the point has been carried a little beyond the middle of the iris, the cutting edge is turned backwards, the point is made to penetrate the iris, and its fibres are divided to such an extent as may be desired. The needle or knife is then rotated into its original position and withdrawn.

Maunoir [1] modified the operation by using scissors for dividing the iris, but of course they required a large corneal wound for their introduction, and neither the linear nor the V-shaped incision which he recommended was found by any means easy to accomplish when the iris had become flaccid after the escape of all the aqueous humour. If scissors are employed at all, the cannula-scissors invented by Wilde would be found far more convenient for incising the iris, as they may be so constructed as to cut their own way into the cornea, and fill up the wound they make, thus retaining a good deal of the aqueous humour. They are now nearly superseded by the forceps-scissors of Weiss.

In cases where a very narrow strip of cornea alone remains transparent, after sloughing or ulceration throughout the rest of its extent, it becomes of the utmost importance to accomplish the division of the iris with as little injury to the cornea as possible. In such cases I have found the most useful instrument to be a broad needle, cutting on both sides for a short distance from its point.

3. *Excision.*—In cases where the pupil had become drawn together, and its contracted area blocked up with an opaque membrane, in consequence of iritis, the lens being unaffected, the operation of incision, either by the knife or scissors, was contra-indicated, since it was hardly possible to puncture the iris with a cutting instrument without wounding the lens. The operation of excision therefore became necessary, which was performed as follows : an opening of sufficient size having been made in the cornea, a forceps was introduced into the anterior chamber, its branches were then opened, a portion of iris was included between them, and, being grasped, was drawn out of the corneal wound, and cut off with scissors. The objection to this operation was the difficulty of limiting the quantity of iris removed ; the pupil was usually very large, and extended almost, if not quite, up to the border of the cornea.

The 'blunt hook,' invented by Tyrrell, introduced a more delicate and precise mode of operating ; and, for special cases, has not been superseded by any subsequent contrivance. It requires only a very small corneal wound for its introduction ; and it can be employed without risk in cases where the lens is *in situ* and transparent.

It is specially adapted for the following cases. First, when, after extraction, there has been extensive prolapse of the iris, so as to obliterate all but a very small vestige of the pupil. Secondly, when, in consequence of iritis, the whole pupillary margin has become adherent to the capsule, the peripheral portion of the lens itself remaining transparent. And, lastly, when the iris is perfectly healthy, but the pupil is hidden behind a dense central opacity of the cornea, the rest of the cornea remaining clear.

a. In a case such as I have alluded to under the first head, we will assume the lens to have been extracted through an upward section of the cornea. The artificial enlargement of the pupil would be made in the following manner : the lids being held apart with a spring-wire speculum, the surgeon steadies the globe by nipping

[1] *Mémoires sur l'Organisation de l'Iris et l'Opération de la Pupille artificielle,* Paris, 1812.

up with a forceps a little fold of the ocular conjunctiva, just above the upper edge of the cornea; he holds in the other hand the broad cutting-needle, which he passes through the lower edge of the cornea, close to its junction with the sclerotic. If the width of the blade be properly proportioned to the size of the hook, a simple puncture will suffice; but if the needle be narrow, its edges may be used to enlarge the wound to a sufficient extent. The needle should now be gently withdrawn; not with a jerk, as such a movement is usually followed by a spurt of aqueous humour, and it is important to retain as much of that fluid as possible. The surgeon then takes the blunt hook, and passes it in through the corneal wound, the flat side of the hook coming in contact with the iris. The instrument, held in this position, is rapidly passed upwards, until its extremity reaches the small pupillary opening; then the handle is rotated so as to allow of the lower edge of the displaced pupil being firmly caught in the bend of the hook; gentle traction is then made, and at the same time the handle is again rotated in such a manner that the short, bent portion faces directly forwards. It is only in this position that the hook can be withdrawn through the corneal wound without catching in it; and it is for the want of attending to this little manœuvre that those who use the blunt hook so frequently find a difficulty in withdrawing it. When the hook, holding the iris, has been fairly brought out of the wound, an assistant, with a pair of fine scissors, snips through the iris, close to the hook, if a good portion of iris has been secured; but should the iris have torn, and only a small portion been withdrawn, it may be desirable to cut through it close to the cornea. Sometimes the tissue of the iris is so much softened that it breaks in coming out, and then the surgeon must use a fine forceps to catch what remains, and so prevent its retracting into the anterior chamber.

Any little shreds of iris that hang in the wound should be returned by means of a little spatula, so that the lips of the wound may come into exact apposition.

The description just given of the mode of using the blunt hook, and of other details in the operation for artificial pupil, will apply to the different modifications subsequently described. The wire speculum, and forceps to steady the globe, will always be found useful, often indispensable. The patient should lie down on a couch; and the best light is usually obtained by the foot of the couch being turned towards the window; the surgeon standing or sitting behind the patient's head. The use of chloroform will be regulated by circumstances; it is commonly necessary with children, or very intractable patients, but the pain of the operation, when skilfully performed, is so trifling, that patients possessed of self-control can usually dispense with chloroform altogether.

b. The next class of cases in which the blunt hook should be employed is that where iritis has terminated in adhesion between the whole or the greater part of the pupillary margin and the capsule of the lens.

At p. 63, under the head of 'Sequelæ of Iritis,' I have described such a condition of closed pupil, accompanied by a bulging forward of the iris, in consequence of the pressure of the fluid secreted in the posterior chamber of the aqueous humour. When the whole surface of the uvea has become adherent to the capsule of the lens, these pouch-like dilatations of the iris do not exist. When only the extreme edge of the pupil adheres, the rest of the uveal surface remaining free, the contracted pupillary area, blocked up with opaque membrane, remains fixed, while the iris bulges all round it, so as in some places to touch the cornea. Partial adhesions of the uvea to the capsule give rise to deep grooves, subdividing the iris into separate pouches; the accumulation of fluid behind the iris being unable at these points to thrust it forwards.

When the whole cornea is clear, and the surgeon can select the position in which to make an artificial pupil, he will find it best to extend it either directly outwards, or directly downwards; and in a case of pouched iris, such as I am now considering, if a depression in the iris exists in either of these directions, he may take advantage of the circumstance to insinuate the cutting-needle and hook between the cornea and iris, without risk of wounding the latter.

When, however, he has succeeded in catching the edge of the pupil, and drawing

out a piece of iris, he may perhaps be disappointed to find that he has removed only its fibrous portion, and that the aperture he has still made is blocked up by a layer of uveal pigment, adherent to the anterior capsule. Although in such a case the first operation may have done but little toward restoring sight to the patient, it will be found to have greatly facilitated a second operation, as the fluid which had been pent up in the posterior aqueous chamber can now find its way into the anterior chamber, and, in consequence, the whole iris will lose its pouched appearance, and recede from the cornea. When the slight irritation caused by the first operation has passed, the cutting-needle may be introduced at a new point of the cornea, the edge of the artificial pupil caught with the blunt hook, and drawn in such a direction as to remove a portion of iris which had never been adherent to the capsule. If the periphery of the lens be transparent, this second operation will at once open a way for the rays of light to pass to the retina.

c. Extensive ulceration at the centre of the cornea, stopping short of actual perforation, may leave a cicatrix so large and opaque as entirely to cover the pupil, restricting the patient's sight to the perception of large objects placed very much out of the line of direct vision. The iris itself, when viewed through the transparent periphery of the cornea, may present a perfectly healthy appearance, and there may be every reason to suppose that the whole globe, with the exception of the cornea, has been unaffected by disease. In such a case, the object of the surgeon will be to displace the pupil either outwards or downwards, accordingly as he finds the outer or the lower portion of the cornea preferable in respect of transparency. The blunt hook is the most convenient instrument for effecting this displacement, as it does not endanger the lens, which I am supposing to be perfectly healthy. An opening having been made, either at the outer or lower margin of the cornea, in the manner described at p. 67, the free margin of the pupil is to be caught with the hook and drawn out, a larger or smaller piece of iris being cut off according to the size of the corneal opacity beyond which the pupil is to extend.

4. *Ligature.*—In spite of every precaution, it is not always possible to limit the size of the pupil, which sometimes opens out to an extent greater than was originally intended. To remedy this inconvenience, Critchett suggested an operation which he termed 'Iriddesis,'[1] and which is applicable to a limited number of other cases of artificial pupil besides that just described; as, for instance, where prolapsus iridis has occurred, and so much of the pupillary margin has been drawn into the cicatrix as to reduce the area of the pupil to a very minute aperture; or where the whole pupil has been displaced towards the extreme edge of the cornea, and there overshadowed by an opacity. A puncture is made through the cornea sufficient for the introduction of a cannula-forceps; a small portion of the iris near its ciliary attachment is grasped, drawn out through the wound, and tied there with a very fine silken thread. This transforms the pupil into an elongated slit. Should this aperture be found insufficient, it may afterwards be enlarged by tying a second portion of the iris in such a position as to draw the pupil into a triangular form.

The operation by *ligature* has the advantage of leaving the margin of the pupil uninjured; and in some cases it has been found that even a certain amount of dilatation and contraction of the aperture has been maintained. It is not now often practised.

It is far from my intention, in treating of ophthalmic surgery, to attempt a record of all the schemes that have been suggested or put in practice. To describe the operations and instruments which artificial pupil alone has called forth would be to enumerate a long and tedious catalogue of inventions, most of which have been long since abandoned as useless.

After-treatment of an artificial pupil.—The various forms of operation I have recommended in the foregoing pages, if skilfully performed, inflict so little injury on the eye, that, provided the parts be in a fit state to undergo the operation—all

[1] *Iriodesis* or *Iridodesis* would be a more correct word to imply tying (δέσις) of the iris, inasmuch as the genitive of ἶρις is ἴριος or ἴριδος.

inflammation being extinct, and the patient's general health having been properly attended to—little more than repose of the eye is required to enable the cornea to heal ; and when that is effected, the wounded iris soon regains its natural texture and appearance. We are often, however, obliged to operate on an iris which has undergone long-continued and repeated attacks of inflammation. The tissue of such an iris is soft and spongy, and its enlarged vessels, when torn or cut, pour out their blood into the anterior chamber, where it may remain for many weeks, or even months, without being absorbed. On the contrary, when the iris is sound, and the patient's health good, but little blood is effused into the anterior chamber, and that little commonly undergoes absorption in the course of a few days.

After an operation for artificial pupil, *both* eyes should be lightly bandaged, or the lids closed with strips of plaster. On the second or third day the eye may be examined. Should there be much sclerotic redness, or intolerance of light, the operated eye must be again closed for a day or two. In most cases, at the end of a week from the operation, a large eyeshade will be sufficient; but the patient must be warned against too soon exposing the eye to strong light ; and if the case be one in which the patient has for several years been limited to perception of light, he must be forbidden to strain his newly-regained powers of sight by premature examination of small objects. A pair of tinted glasses should be worn for some time after he has begun to go out of doors.

If the operation has been performed under chloroform, it may not be advisable to give any opiate or narcotic at night ; but in excitable patients, who have not taken chloroform, it is sometimes necessary to give some mild narcotic. From twenty-five or thirty minims to a drachm of tinct. hyoscyami, in camphor-mixture, is what I usually order as a night-draught for an adult who has not been habitually addicted to the use of opiates. But many patients do not require anything of the kind. There is no reason for denying the patient a moderate quantity of plain animal food on the day of the operation, as well as on the following days. Nor should stimulants be wholly forbidden to those who are accustomed to their daily use. I need hardly say that a patient who is to spend the first day after the operation in bed, and perhaps the rest of the week in the house, is not to live as freely, and have the same amount of stimulants, as if he were taking daily exercise, and were engaged in active pursuits. But, on the other hand, it is absurd to keep a patient on low diet, and deprived of all accustomed stimulants, because a small puncture has been made in his cornea, and a little bit of his iris removed. Old and feeble persons cannot bear such reduction ; and if any considerable quantity of blood has escaped into the anterior chamber, the best way to hasten its absorption is to keep the patient's powers up to a healthy standard, by plain nutritious diet, and just such an amount of stimulants as will maintain the circulation at a proper point of vigour.

CHAPTER VII.

DISORDERS OF THE CHOROID, RETINA, AND OPTIC NERVE.

The genetic association of the hexagonal pigmented epithelium of the choroid with the retina, the nourishment of the bacillary layer of the latter by the chorio-capillaris, and the frequent and ready extension to the retina of morbid processes beginning in the choroid, induce us to treat of the diseases of these coats in one chapter.

Coloboma.—Whilst describing coloboma iridis, reference was made to the backward extension of the cleft through the deeper structures in some instances concurrent with it. This defect is due to imperfect closure of the cleft which grooves the lower half of the embryonic eyeball, and discovers itself ophthalmoscopically by a white oval or pear-shaped figure stretching from before backwards along the lowest part of the fundus oculi. In extreme examples the narrow, tapering end of this

figure is traceable nearly or quite up to the fissure in the iris, whilst the larger rounded end includes the optic papilla. In such cases the upper half of the sclero-choroidal foramen is normal, but the lower half appears absent; there the papilla seems to an inexperienced observer to merge without definite limit into the white figure of the coloboma. It is, however, always distinguishable from this by its pinkish-grey colour, and its less bright reflex. In such extreme examples of coloboma the branches of the central vessels distributed to the upper half of the retina are usually larger and more conspicuous than those supplied to the lower half. Where the coloboma is of less extent and it does not include the sheath of the optic nerve, the larger end of the white figure is separated from the papilla by a band of normal choroid.

The area of the coloboma is formed by a connective-tissue membrane intercalated between the edges of the sclerotic defect, which often lies in a slightly deeper plane than the parts around, as if bulged slightly outwards. An excess of pigment in the choroid along the margins of the white figure intensifies their distinctness. The retina in some instances appears to span the hinder part of the coloboma, and in others to be applied to the intercalated connective-tissue membrane. That it is structurally defective is shown by a corresponding defect in the visual field.

Diseases of the Choroid.

1. *Hyperæmia.*—Ophthalmoscopically, congestion of the choroid is inferred from increased redness, dilatation, and varicosity of the larger blood-vessels, particularly of the veins. The deeper redness is the collective effect of turgescence of the choroidal capillaries, which even when swollen are not recognisable individually. In estimating it regard should be had to the quantity of pigment present in the choroid, the appearances noted in one eye should be controlled by those observed in the other, and the natural differences of size and arrangement of the veins in different regions of this coat should ever be kept in mind. The vascular system of the choroid has three areas between which there is less free intercommunication than between the vessels within each area. There are a posterior area chiefly fed by the posterior ciliary arteries, an anterior area to which the short anterior ciliary arteries are distributed, and the area which includes the venæ vorticosæ with their tributaries. Where the choroid is deeply pigmented, the condition of the vascular system will be masked or even completely hidden.

2. *Choroiditis.*—Inflammatory exudations infiltrate and swell the stroma, or distend the looser tissue which connects the choroid with the sclerotic, or are poured out upon the inner surface of this coat between it and the retina.

The presence of exudation destroys the natural transparence of the choroidal tissues, and thus masks the sharpness of their ophthalmoscopic image. It is not always easy or even possible to ascertain with perfect certainty the precise seat of a slight exudation. Where the transparence of the retina is preserved and the vessels of this coat are distinctly traceable across the opaque patch, the exudation is behind them in the outer layers of the retina, or upon or within the choroid.

Frequently a past choroiditis leaves indelible traces: white spots, the inner surface of the sclerotic exposed to view by the disappearance of pigment and atrophy of the choroidal tissues, stamp the former foci of inflammation, whilst brown or black fringing borders due to excessive formation of pigment indicate the zone of hyperæmia. (Plate I. fig. 3.)

Diseases of the Optic Nerve and Retina.

Slight variations in the contour-figure of the optic papilla so frequently coexist with perfect functional integrity, that they should not be hastily looked upon as evidence of disease: they may be merely a congenital peculiarity, or an illusion due to a somewhat high degree of astigmatism.

Morbid changes in the form of the surface of the papilla are of two kinds, depression and elevation. The inexperienced observer should not mistake for a

morbid depression the slight central hollow, known as the physiological pit. Its extent and precise figure vary within small limits which are fixed by the arrangement of the outer layers of the retina at the sclero-choroidal foramen.

Depression.—Morbid depression is partial or general, and may be due to atrophic wasting alone, or to pressure followed by atrophy. Where due to atrophic waste alone; the surface of the papilla declines gradually from the periphery towards the middle, and it takes the form of a shallow, shelving saucer; and where produced by pressure and atrophy, the depression is abrupt, assuming the shape of a cup, and it may even undermine the margin of the sclero-choroidal foramen. (Plate II. fig 3.)

Ophthalmoscopic signs of depression of the surface of the papilla are (1) the altered direction of its blood-vessels, which are bent out of their natural course; (2) the unnatural distinctness of the details of the lamina cribrosa beyond the normal limits of the physiological pit; (3) a certain distribution of light and shade when the papilla is illuminated; and (4) the increased parallax of the images of objects lying over the margin of the sclero-choroidal ring above that of the images of structures lying near the middle of the papilla and not far from the inner surface of the lamina cribrosa.

Where the depression is slight and the slope gradual, the direction of the smallest visible vessels is a better guide than that of the larger vessels, because the smaller vessels on account of their minuteness are only apparent when they follow closely the surface of the papilla. Where the hollow is deep and abrupt, reaching or undermining the edge of the sclero-choroidal foramen, the change in direction here of the large branches of the vena centralis is very significant. Those portions of the veins which lie in the papilla appear to be angularly bent; and where the hollow is very deep and its sides steep and overhanging, the apparent lateral deflection of the veins is so great that the continuity of these vessels with their continuations in the retina seems to be interrupted.

Elevation of the surface of the optic papilla, of slight extent and partial, is present where as a congenital defect the nerve fibres retain their white substance which augments their bulk. Such elevation is usually partial, affecting some segments of the papilla only. The white nerve-fibres may extend some distance into the retina in the form of white, radiating bands which may be distinguished from exudation by their brush-like feathered borders. But the common causes of elevation are congestive and inflammatory swelling. In estimating the value of redness of the papilla as an index of capillary congestion, the influence of contrast between the colour of the papilla and that of the fundus oculi around it must be kept in mind; and in judging of the import of an apparent turgescence of the vena centralis, the observer should take into account the refraction of the eye, because in the indirect method of ophthalmoscopic examination, the same collecting lens being used, where hypermetropia is present vessels of the same actual diameter appear larger, and in myopia they appear smaller, than in emmetropia.

Congestive Swelling of the Optic Papilla.

(*Neuritis; Neuro-retinitis.*)

Congestive swelling of the optic nerve is ophthalmoscopically indicated by undue redness; by loss of transparence due to œdema which dulls the sharpness of the images of the lamina cribrosa, the margin of the sclero-choroidal foramen, and those portions of the vasa centralia which lie at some depth beneath the inner surface of the papilla; and by turgor of the veins which betrays itself, not solely by their unnaturally large calibre, but by arched direction in the papilla, and their tortuous course in the retina indicative of their elongation. In order to sharply see the summit of the swollen papilla and the surface of the surrounding retina, the observer is under the necessity of varying his accommodation, which proves that they lie in different levels.

The distinction between congestive and inflammatory swelling of the papilla is not always easy to make, for these conditions are not always sharply defined; indeed, one often merges insensibly into the other. In neuritis there is greater opacity, due

to exudation amongst its tissues, imparting to the papilla a dull grey colour, in some instances tinged with a rusty stain, caused by extreme capillary engorgement and minute hæmorrhages. The arteries are more or less obscured; and the veins, always more conspicuous than the arteries, in consequence of their larger calibre and the greater tenuity of their walls which allows the purple blood-colour within them to be better seen, are visible only in those parts of their course which lie close beneath the inner surface of the papilla. The borders of the sclero-choroidal foramen are concealed, and peripherally the optic nerve passes without definite limit into the surrounding retina. The opacity not infrequently extends for some distance into the retina, particularly along the course of the larger blood-vessels. A faint radial striation is often apparent in the circumferential part of the papilla and adjoining retina.

Congestive swelling and neuritis may end in resolution and perfect recovery of sight, but too often they terminate in atrophy and blindness. The last is especially true of neuritis, after which the swelling of the papilla lessens, its opacity clears up, it acquires a pale greyish or bluish-white colour, it has a bloodless appearance, the turgescence of its large vessels is replaced by unnatural decrease of calibre, whilst their tortuosity persists, and its margin is frayed, blurred, ragged. A fact long recognised by ophthalmic surgeons, and particularly insisted on by Dr Hughlings Jackson, cannot be too widely known, viz. that congestive swelling and neuritis are not infrequently in their early phase compatible with good sight. Usually, however, before long visual acuteness suffers and the field becomes contracted. Congestive swelling and neuritis are both frequent concomitants of disease behind the eyeball within the skull. They may be occasioned by extension of inflammation forwards along the post-ocular part of the nerve to that within the eyeball, and by any circumstances which unduly raise intracranial pressure. It is the frequent relation of congestive swelling and neuritis to intracranial disease which makes the prognosis so grave. Where dependent on intracranial disorder optic neuritis is usually double, but an interval of weeks, and even months, may intervene between its appearance in one eye and its supervention in the other.

In a few cases the origin of the neuritis is traceable to a post-ocular but intra-orbital cause, such as a tumour compressing the nerve. In another class of cases it is an accompaniment or the sequel of some acute general disorder, as diphtheria, rheumatic fever, or one of the exanthemata; and in a third class its subjects are young chlorotic females.

The treatment will vary with the cause. If this is presumably a post-ocular syphilitic gumma, potassic iodide or mercury should be given. If the patient is a feeble convalescent from an acute general disorder or a chlorotic girl, iron with cod-liver oil deserves the preference, and mercury should be given in small doses, if at all. The local abstraction of blood with the artificial or natural leech appears to be beneficial where there is great vascular turgescence in the papilla.

Atrophy of optic nerve. (Plate II. fig. 1.)—This is a sequel of a coarse neuritis, and it also occurs unpreceded by such coarse inflammatory alterations as are recognisable with the ophthalmoscope, often in association with spinal disorder. It is in some instances the direct consequence of unduly heightened intracocular pressure. It has been observed in association with exhaustion depending on sexual abuse, and also in connection with inordinate use of tobacco. When it is the result of neuritis, the contour of the nerve is often blurred and wanting in the sharpness of definition which stamps simple atrophy; and until a very considerable interval has elapsed since the occurrence of the neuritis, the papilla is greyish rather than white; whereas in simple atrophy, contrasting strongly with the redness surrounding it, the optic nerve at once attracts attention by its extreme whiteness, which resembles that of ivory, rather than the creamy or faintly pinkish tint which has been described as characterising the nervous tissue in a state of health. These dense-looking, homogeneous nerves have undergone *white atrophy*, and have lost the greater portion of their true nervous element, little more than the fibrous tissue remaining. (Plate III. fig. 2.) The appearance of such a homogeneous, white, optic nerve, at once assures the practised observer that the case is quite beyond recovery.

The surface of such wasted nerve is depressed; it slopes gently from the border towards the centre. The vasa centralia are contracted or finally even obliterated, though the veins are often during some time unnaturally conspicuous through their strong contrast with the blanched nerve.

Treatment in cases of advanced atrophy is useless. At an earlier stage the removal of inordinate pressure where this exists, as in glaucoma, may stay its progress. When associated with sexual excess, or with the inordinate use of tobacco, abstinence and the internal exhibition of strychnine and iron will in some instances obtain unexpected improvement, and these drugs also appear occasionally to effect some improvement in the atrophy which attends spinal disorders. The general improvement in the patient's health where the exhibition of these drugs appears beneficially to influence the atrophy of the nerve, suggests that their influence upon the nerve is indirect.

Retinitis.—The ophthalmoscopic signs of retinitis are essentially of the same order as those which mark neuritis; they are loss of transparence, swelling, and engorgement of the blood-vessels, producing opaque greyish patches often blotched with a rusty stain from admixture of extravasated blood, and dilatation with tortuosity of the veins, which together with the arteries appear interrupted where overlaid and concealed by some thickness of opaque retinal tissue. The heightened blood-pressure upon their walls produces minute aneurismal dilatations, which, bursting, are the source of minute capillary hæmorrhages, and it even causes rupture of veins occasioning not infrequently large extravasations which when recent appear as crimson blotches and brushes. Their form depends on the seat of the hæmorrhage. The escaping blood takes the lines of least resistance; hence hæmorrhages in the inner layers are usually brush-like, long splashes, and in the outer layers they have the form of round spots and blotches.

A detailed account of all the forms of retinitis which authors have described, is beyond the scope of this article: it must suffice to briefly notice the more prominent. In one form of retinitis (*hæmorrhagic retinitis*) the retina is more or less closely spotted with blotches and brushes of extravasated blood, between which the transparence of the coat is impaired only in a degree indicating a very slight amount of œdema or exudation. Repeated hæmorrhages are usual. The most recent are crimson, the least recent are buff-coloured, and between these extremes every shade of red and rust colour is noticeable. The subjects of this form of retinitis are often middle-aged and elderly persons.

In another form the retina around the optic papilla becomes grey and opaque; the opaque area is dotted with minute hæmorrhages which may coalesce in larger spots, and the papilla itself is similarly stippled. The veins are very turgid and tortuous, and concealed where they dip deeply away from the inner surface of the coat. Soon small white dots appear in and around the opaque grey parts, often coalescing in larger patches; and, which is very characteristic, a peculiar radial grouping of glistening white dots, to which attention was first called by Liebreich, may be noticed at the macula lutea. Frequently, however, the ophthalmoscopic picture is less typical than that just described, deviating in the greater or less prominence or in the combination of the details. This form of retinitis (the *albuminuric*) occurs in connection with renal disease, and its subjects are often in such apparently good health that, until suspicion is excited by the retinal disorder, the existence of kidney disease is undiscovered.

The progress of the retinal disorder is in intimate relation with that of the kidney, frequently receding when this improves, and augmenting when this increases. Such fluctuation of albuminuric retinitis may be frequently observed in women during and between successive pregnancies. In such patients, especially during the later months of pregnancy, the retinal disorder greatly increases, and after delivery all signs of retinitis may disappear. As regards treatment, mercury is inadmissible, and leeching does not appear to influence the disorder. The tincture of sesquichloride of iron is thought to be useful.

Syphilitic retinitis.—Another form of retinitis occurs in syphilis. There is more

exudation, producing larger and less defined opaque grey blotches, and hæmorrhages are a less prominent feature than in the forms already described. It is often associated with, and not infrequently consecutive upon, choroiditis and iritis. A larger number of cases are met with in the early than occur in the latest stage of constitutional syphilis. For the treatment mercury is preferable to iodide of potassium.

Chlorotic retinitis.—Retinitis is so frequently seen in young females suffering from chlorosis, that a causal relation may be not unreasonably inferred to exist between this and the retinal disorder. The ophthalmoscopic signs do not essentially differ from those of the syphilitic form, but chlorotic retinitis is more often combined with neuritis than is observed to occur in syphilitic retinitis, and choroidal and iritic complications are absent. The age and circumstances, and the entire absence of other symptoms of syphilitic taint, absolutely exclude the idea of a syphilitic origin in many of these cases. If treated early, recovery is not very infrequent. Iron is most useful.

Retinitis pigmentosa. (Plate II. fig. 2.)—The presence of pigment in the retina stamps this form of retinitis. The pigment occurs in irregular star-like aggregations and nets of lines, often following the course of the larger blood-vessels. Whilst not denying that it may be formed within the retina, the belief is strongly held by some that the pigment is derived from the choroid, which is strengthened by the frequent concurrence of unmistakable signs of choroiditis. The disorder begins at the periphery of the retina and creeps backwards towards the optic nerve, leaving the retinal tissues atrophied, the obliterated larger blood-vessels appearing as opaque lines. This form of retinitis usually begins in very early life, it often affects several members in a family, and it has been thought by some to be more common in the offspring of marriages of near blood relationship. The centripetal progress of the disorder in the retina produces a corresponding contraction of the visual field; and a person so affected has difficulty in finding his way about after dusk, whilst his central vision may yet be so good that he reads, without trouble, ordinary type. In the advanced stage of the disorder central vision is also blunted, and finally lost when the parts of the retina around the posterior pole of the eye ball, including the macula and optic papilla, are atrophied.

This form of retinitis is not controlled by any yet known treatment.

Retinal Hæmorrhages.

Extravasation of blood, either from the retina or the choroid, constitutes, I need hardly say, one of the most serious accidents to which those coats are liable. The blood may be effused in consequence of a blow on the eyeball, or it may escape spontaneously from a distended vessel giving way, as in ordinary apoplexy. The occurrence of hæmorrhage in neuritis and retinitis has been already noticed.

It is remarkable that rupture of a retinal vessel sometimes occurs without any of the symptoms which one might expect would accompany it—such as giddiness and other signs of cerebral disturbance. I have seen many cases in which a dimness or cloudiness has suddenly overspread one eye, while the patient, in apparently good health, was quietly engaged in reading or writing; no pain or uneasiness of any kind accompanying the attack, the iris retaining its mobility, and even the conjunctiva and sclerotic showing no trace of increased vascularity. The patient finds that a considerable portion of his field of vision has became a total blank as regards perception of objects; while, perhaps, he still retains the power of dimly discerning those which happen to fall on some limited portion of the retina. If such a case is examined within a few hours, or even a few days, after the rupture of the vessel, the fresh red colour of the effused blood will at once be recognised. If it is one of the radiating vessels of the retina that has given way, the prognosis will be much more favourable than if the hæmorrhage had come from the choroid; for, in the former case, the tissue of the retina, although for a time overspread with blood, and so rendered incapable of receiving visual impressions, may have escaped any serious

disintegration; whereas, if the blood has proceeded from the choroid, it may have actually ruptured the retina, and irreparably destroyed that portion of it as far as its function is concerned. The presence of clots freely floating in the vitreous humour would be a still more unfavourable sign, as it would prove that the tissue of the vitreous body had, to a certain extent, been broken up. This latter complication more frequently results from blows on the eyeball than from spontaneous apoplectic extravasation.

No one who has had a little practice with the ophthalmoscope can find any difficulty in detecting a recent extravasation of blood on the surface of the retina; but the recognition of the changes which mark the site of old extravasations is often extremely difficult. I have already noticed the cases in which a rupture of choroidal vessels breaks up and destroys a limited portion both of the choroid and retina, leaving either a well-defined space of white sclerotic, or a patch of dark pigment, to mark the site of the disruption. But a less extensive extravasation, originating in the rupture of a superficial vessel of the retina, may leave such faint traces as almost to escape observation. Sometimes the site of the rupture is marked by a slight brownish stain, in other cases by a faint mottling of the retinal surface; while a more extensive extravasation may so far damage the retina as to leave in after-years a linear or stellated cicatrix (if one may so term it), of a lighter colour than the surrounding tissue.

Embolism of the Central Artery.

The obstruction is in a trunk of the artery before its subdivision, or in one of the branches. It reduces vision suddenly to bare quantitative perception of light involving the whole or part of the visual field. Where the trunk of the artery is plugged the optic papilla appears blanched, and the vasa centralia, much contracted, are nearly emptied of blood resembling white threads, in which slender red cylinders are intercalated where they still contain a small quantity of blood. When the embolus blocks one of the arterial branches, similar appearances are observed in the area within which it is distributed. The macula lutea soon after becomes opaque, forming a dull greyish oval patch enclosing a small central red spot, which is deceptively like hæmorrhage, but is really the choroid, apparent here through the thin retina.

Detached Retina.

(*Solutio retinæ; Hydropisie sous-rétiniaire*).

Serous effusion between retina and choroid may occur as a result either of acute or chronic inflammation of the choroid; or it may be produced by traction upon the inner surface of the retina, relatively lowering the pressure upon the outer surface of the choroidal capillaries. *Chronic* effusion between the retina and choroid may take place in the most gradual and insidious manner, so as only to manifest itself by impairment of vision, unattended with any pain or external signs of inflammation. Detachment of the retina from the choroid not infrequently supervenes on sclero-choroiditis posterior in high degrees of myopia in advanced life.

When the retina has become detached to a very considerable extent, a corresponding portion of the field of vision becomes a total blank, so far as perception of objects is concerned; while that portion of the retina which remains in apposition with the choroid may still distinguish even small objects, although in an imperfect and partial manner.

There are no external signs by which we can ascertain the existence of effusion beneath the retina. The ophthalmoscope alone enables us to detect it.

The effused fluid may either exist in such a small quantity as barely suffices to impart a cloudy appearance to a limited portion of the retina; or it may have detached a considerable extent of the retina, or even the whole of it, from its connection with the choroid.

The more limited effusions frequently occur in the immediate neighbourhood of

the optic nerve. They tend to sink to the most dependent part. At first sight they appear as greyish or cloudy patches in the midst of healthy tissue, and the retinal vessels which are spread out over the rest of the fundus of the eye appear to be lost when they arrive at the edge of the patch. This appearance is owing to the fact of the vessels being raised up by the effusion beneath them, so that they are on a plane different from that of the vessels of the healthy retina. A slight movement of the convex glass, when the indirect method of ophthalmoscopy is employed, will at once bring into the focus the vessels overlying the effusion.

When a large portion of the retina has been separated, it presents the appearance of a lobular mass, of an opaque greyish colour, contrasting in a remarkable manner with the reddish surface of that part of the fundus oculi where the retina still retains its natural position and transparence. Sometimes the lobular mass may be observed to oscillate with each movement of the eye, and when brought into focus upon its surface are seen ramifying vessels, the displaced veins of the retina, which are lost to view where they dip between the lobules, and thus appear to be frequently interrupted.

When almost the entire retina is detached from the choroid, the appearances under the ophthalmoscope are at first very difficult to understand. The whole fundus of the eye appears at one moment of a dull pearly grey, as if covered with a milky gelatinous deposit; then the white disc of the optic nerve comes for an instant into view, and then again a sudden turn of the eyeball affords a glimpse of some very limited portion of undisplaced transparent retina, where the fundus oculi still dimly reflects the luminous rays which fall upon it. Not infrequently the view is still farther confused by floating bodies dispersed through the vitreous humour.

The course of this disorder is often very chronic, and may be interrupted, but its tendency is progressive; and though exceptionally the effusion may disappear and the retina become reapplied to the choroid, much more frequently the whole of the nervous tissue is eventually stripped from the choroid and the visual field curtailed until sight is finally lost.

Strict rest of the eyes and avoidance of all strain should be enjoined. Iodide of potassium and corrosive sublimate are frequently prescribed, but they do not seem to avert the final result. The failure of internal remedies has led to attempts to restore the balance of pressure on the two surfaces of the retina by puncturing or tearing this freely with one or a pair of needles introduced through the choroid for the purpose of making a free communication between the space occupied by the effusion and the vitreous humour. The immediate results of this are occasionally very promising; unfortunately they are not permanent, and the operation has in a few instances produced increased choroiditis and hastened the destruction of sight.

Tumours of the Choroid and Retina.

The majority of primary tumours of the eyeball are referable to sarcoma and its variety glioma, and but few can be referred to carcinoma in its present restricted sense. The sarcomatous and carcinomatous tumours begin usually in the choroid, and glioma takes its origin in the connective substance of the optic papilla or retina. The occurrence of glioma is almost without exception restricted to early childhood, whilst sarcoma and cancer are unusual before adult life. With respect to glioma no causative antecedents are known, but sarcoma and cancer both so frequently arise in eyes which have been spoiled by inflammation that such inflammatory disorganisation of the ocular tissues may fairly be considered a predisposing cause. In their course and end glioma and sarcoma of the eyeball are as destructive as carcinoma.

As glioma affects children of very tender years, not infrequently whilst still in arms, its earliest symptom is not conscious loss of sight, but often the mother or nurse is first made aware of something unnatural by a bright yellowish reflex from the bottom of the eye shining through the pupil. This occurs when the growth has advanced so far in front of the posterior principal focus of the eye that luminous rays reflected by its summit emerging from the pupil undergo dispersion. If it be now examined with the ophthalmoscope, the extent and form of the tumour can be

recognised. Continuing to grow and to infect all the structures with which it comes into relation, the tumour distends the eyeball, which becomes hard and painful. The vitreous humour loses its clearness, the lens is thrust against the cornea, this in time grows cloudy and then sloughs; after which, released from constraint, the tumour sprouts out of the front of the eyeball and forms a large fungating mass which may protrude to a considerable distance between the eyelids. Whilst this is proceeding, the glioma often infects and passes through the sclerotic where this is thinnest behind the insertion of the tendons of the recti muscles; it escapes along the foramina of exit of the venæ vorticosæ, and it also creeps backwards along the optic nerve, entering the cranium and infecting the chiasma. It is not very unusual for glioma to spring up in the other eye. Should the child survive a sufficient time the diploe may become the seat of secondary knots, and in very rare instances such knots have been found in distant viscera, *e.g.* liver; but usually this is anticipated by death. Early excision of the eyeball, including, if the disorder is at all advanced, the other orbital tissues, with section of the optic nerve short in front of the bony foramen, will often afford a respite, but quick recurrence very usually takes place. The ophthalmoscopic signs of a choroidal sarcoma or carcinoma do not widely differ from those of glioma. Seated primarily in the choroid and often pigmented (melanotic), these tumours do not usually betray their presence by the bright yellow reflex so characteristic of glioma. They also often lead to detachment of the retina from the choroid, which still further conceals their presence and may lead to mistaken diagnosis. The tension of the eyeball here will sometimes give a hint. In simple detachment of the retina it is not usually excessive, but often unnaturally low; whereas in retinal detachment complicating a choroidal tumour, the tension, gauged by the hardness of the eyeball, is generally greater than normal. The course and final result are so similar to those of glioma that it is unnecessary to dwell upon them. Early and free excision of the eyeball alone offers a long immunity from return. In one instance within the reviser's experience this respite lasted seven years. Even when the new growth has infected the orbital tissues, excision may still be practised in the absence of symptoms indicating intracranial extension. The free use of zinc-chloride for the purpose of destroying small portions of tumour which may have escaped removal with scissors or knife, is here strongly recommended. In these cases the liver is the organ in which secondary growths are most often found.

CHAPTER VIII.

VISUAL DISORDERS.

An anatomical classification of eye-diseases—the arranging of them, that is to say, according to the changes of structure which cause the impairment of sight—has such obvious advantages that it has become almost universal among ophthalmic writers; but it has the inconvenience of offering no heading under which to place certain defects which cannot be precisely demonstrated as originating in any one part of the optic apparatus.

Of this kind are the various luminous appearances depending upon some temporary disturbance of circulation; Chromatopsia, Teichopsia; occasional obscuration of half the field of vision (*Hemiopia*); the condition termed *Hemeralopia*; congenital inability to distinguish certain colours; spectral illusions, &c.

Hemiopsia, Hemiopia.—Obscuration of half of the visual field, not to be taken strictly literally, when permanent, depends on defect in the corresponding hemisphere of the retina, or of the nerve-bundles ending in this, or else in their central connections. Thus in detachment of the retina, implicating its most dependent segment, the corresponding upper part of the visual field above the level of the eye is often blotted out, and a similar curtailment may be caused by a retinal hæmorrhage. Transient hemiopsia is often an initial symptom of megrim, and in such cases no morbid appearances are recognisable with the ophthalmoscope. The ocular symptoms

begin with an obscuration compared to that which follows looking at the sun. Usually this starting from one point in the visual field spreads centrifugally until it blots out a considerable extent of it. The margins of this scotoma are in some instances fringed with an indented border of luminous colours which rapidly oscillates. In such cases the disappearance of the ocular symptoms is followed by intense sick headache. For an excellent discussion of this subject the reader is referred to 'Lieving on Megrim and Sick Headache.'

Hemeralopia.

Hemeralopia—literally 'day-sight'—is a term used to designate a peculiar form of intermittent blindness, the subjects of which see perfectly in broad daylight, but lose all power of perceiving objects as soon as the sun has set, and twilight commences. The persons in whom the affection is most frequently met with in this country are those just returned from sea voyages, especially from the East or West Indies. It is also frequent, I am told, among the natives of the inland parts of India, who attribute it, as our own sailors do, to sleeping exposed to the moonbeams.

The real cause of hemeralopia appears to be exhaustion of the nervous power of the retina from over-excitation by the sun's rays, so that the part is rendered incapable of appreciating the weaker stimulus of twilight or moonlight. That this is the true explanation of night-blindness is demonstrated by the fact that night-blind sailors who cannot see to find their way about on decks see well in the cabin where a bright lamp is burning. There are not any characteristic ophthalmoscopic signs; the fundus oculi does not in this disorder exhibit any morbid appearances. Exposure to tropical light, however, is not the sole cause of the affection; for I have met with it in persons who had never quitted the temperate regions of the globe; but in most of these latter cases the complaint had shown itself after long voyages, which had subjected the patients to exhausting toil and exposure to severe weather, while deprived of a proper supply of fresh provisions and vegetables.

In these latter cases I have commonly found that a few weeks' residence on shore, with a mixed vegetable and animal diet, and the use of quinine, has restored vision to a healthy state.

Nyctalopia—'night-sight'—would imply inability to see by daylight, the exact converse of hemeralopia. In a certain sense, patients affected with that irritable form of corneal inflammation commonly called 'strumous ophthalmia,' might be termed nyctalopic, so unable are they to bear strong light, and so willing to open the eyes and look about them in the dimness of twilight; but, apart from inflammation, I have never met with nyctalopia to the extent described by authors; and I am inclined to consider the affection an imaginary one, invented, as it were, to form a companion disease to the hemeralopia just described.

Colour-blindness.

Imperfect perception of colours in slight degrees is a very common defect. In high degrees it was, until lately, thought to be of very exceptional occurrence; but recent investigations have revealed that in Europe, and in the United States, inability to recognise some colours is present in so high a degree, in about four persons in one hundred, as to render the employment of such individuals perilous to public safety where this depends on the prompt and accurate recognition of coloured signals. Holmgreen,[1] in which he is followed by J. Jeffries,[2] distinguishes three forms, in relation to the three fundamental colours; red, green, and violet (blue) blindness. The red-blind person is sensible of two fundamental colours only in the solar spectrum, which are green and violet. Spectral red and yellow appear to him greens. The green-blind individual perceives only the red and violet (blue) in the spectrum; he confounds yellow with red, and green with violet. The violet-blind person mistakes blue and violet for green.

[1] *Die Farbenblindheit in ihren Beziehungen zu den Eisenbahnen und der Marine.*
[2] *Colour-blindness; its dangers and its detection.*

In the examination of persons for the detection of these defects, those methods which require the individual under examination to match but not to name colours are to be preferred. Such a method is that of Holmgreen, which has been very widely adopted. The examiner selects from a large number of skeins of Berlin wool, which can be had in every shade and variety of colour, a few as tests, and requires the person under examination to place with these those which appear to him to be of the same colour and shade. If a pure light green has been selected as the test skein, and the person who is being examined places together with shades of this other skeins of greys, reds, yellows, or blues, he is manifestly colour-blind. He is next asked to match a purple skein. If, together with other similarly coloured skeins, he puts others coloured blue and violet, he is red-blind; whilst if he confounds with purple greens and greys he is green-blind. As a control test a bright, pure red skein is chosen. This a red-blind person matches with shades of green and brown which appear to a normally sighted examiner darker than the red, whilst a green-blind person chooses out opposite shades which appear to the examiner darker than the bright red test. A violet-blind person confounds with the purple skein others of red and orange. In the greater number of instances colour-blindness is a congenital and irremediable defect, but it is occasionally acquired; its accession, after severe head injuries and vascular disorders of the optic nerve and retina, is a well-established fact.

CHAPTER IX.

DISEASES OF THE VITREOUS BODY.

Before the invention of the ophthalmoscope, little was known about the morbid conditions of the vitreous humour. It was frequently found to become diffluent (*synchysis*) after injuries to the eyeball, and during the progress of certain chronic inflammations; and it was assumed to play an important part in glaucoma. The ophthalmoscope presents to our view a great variety of morbid products in the humour, which it is difficult to observe with accuracy, on account of the rapidity with which many of the flakes, filaments, and corpuscles float about with every movement of the eye.

When *hæmorrhage* occurs from the ciliary processes, or from the superficial vessels of the retina, or bursts through the retina from the choroid, a portion of the clot not infrequently becomes entangled in the vitreous humour, and forms an irregular, filamentous, black-looking body floating to and fro across the illuminated field of the ophthalmoscope.

In *syphilitic inflammation* of the deep tissues, the vitreous humour loses its perfect transparency, and becomes turbid; and in severe cases, flakes of lymph are seen freely moving about in it, like tangled blackish threads.

Many of these and similar opacities are products of the proliferation of the embryonic connective-tissue corpuscles which throughout life persist in the membranous dissepiments of the loculi of this body. In suppurative inflammation the pus-corpuscles which pervade this humour are believed to be offspring of these corpuscles.

In syphilitic cases it is sometimes surprising to observe how much such opacities clear up under the exhibition of mercury.

A very singular phenomenon connected with the vitreous humour is that termed *sparkling synchysis* ('synchysis étincelant'), produced by the presence of crystals of cholesterine, which at each movement of the eye appear as innumerable brilliant points, like the finest gold-dust, sparkling in the dark area of the pupil. When the eye is kept at rest these crystals gravitate to the bottom of the mingled aqueous and vitreous humours, some sinking down behind, and some in front of, the iris.

Cysticerci.—Perhaps the most striking phenomenon connected with the vitreous humour is the presence of entozoa, either freely floating within it, or protruding

into it from the surface of the retina, to which they are attached. By far the greater number of cases of this kind which have been recorded are to be found in foreign journals, for hitherto only a very few have been observed in this country.[1]

Of twenty cases reported at the date of the last edition of the work in various numbers of the *Archiv für Ophthalmologie*, the majority appear to have been under the care of A. von Graefe. In *eight* cases the cysticercus was either embedded in the very tissue of the retina, or firmly adherent to its surface; in *six* cases the creature appeared to be behind the retina; while in *six* others it was quite detached, and floated freely in the vitreous humour. This latter circumstance induced Graefe, in two instances, to attempt its removal; in the first case making an incision in the sclerotic and passing in a forceps through the wound; in the second adopting a slower and more complicated proceeding. First, a portion of the iris was excised, so as to make a large artificial pupil; then, when all irritation had subsided, the lens was extracted through a flap-section of the cornea; and lastly, after a considerable interval of time had been allowed to elapse, a forceps was introduced through a fresh opening made in the cornea, and the cysticercus grasped and drawn out.[2]

From a review of all these cases, it appears almost certain that the cysticerci found loose in the vitreous humour had attained that position by perforating the retina, having been originally formed between that tissue and the choroid, in which situation it seems that all the cysticerci above described were originally developed.

In a more recent volume of the *Archiv*, Graefe gives the total result of his experience as to the occurrence of cysticercus (xii. 2, 174; 1866). During thirteen years 80,000 patients had attended his clinique, and among them rather more than 80 cases of cysticercus in the deep tissues of the eye had been observed: 3 had been seen in the anterior chamber; 5 under the conjunctiva; 1 in the substance of the lens; 1 in the orbit. The ages of the patients varied from eight years to seventy.

I believe it has been well ascertained that the inhabitants of Northern Germany are more liable to tape-worm than those of the British Islands, and this circumstance would account for the fact of the cysticercus having been so much more frequently met with in the former country.

Muscæ volitantes.—The little threads and spots which, by some persons, are seen to float and glide over their field of vision, were formerly attributed very commonly to congestion of the choroid. Tyrrell, for instance, assigned as their cause 'a preternatural dilatation of some of the delicate vessels' of the part. It seems strange that any one could overlook the fact that *fixed* bodies—which dilated vessels of the choroid must be—if they pressed upon the retina so as to impair its function, would suggest to the patient the idea of *fixed* spots in the field of vision, which could only appear to move when the eyeball itself was set in motion. The spots known as *muscæ volitantes*, on the contrary, change their position whenever the eye is suddenly moved; and when the eye is again fixed, the spots still continue for a time to float about in various directions, eventually appearing to descend, as if sinking in a fluid.

They are most commonly met with in short-sighted subjects, and are quite compatible with life-long continuance of the acute powers of vision which such persons frequently enjoy. They are usually first noticed between the ages of twenty and thirty; and when they have begun to attract the patient's attention, they appear rapidly to increase in number. This apparent increase is partly due to the fact that, by anxiously watching them, the patient soon acquires a habit of bringing fresh bodies into view.

If the eye be turned towards a clear sky or a bright cloud, and then kept steadily

[1] Teale gives the history of a case occurring in his own practice in 1864 (*Ophth. Hosp. Reports*, vol. v. p. 318). Bowman reports another (op. cit. vol. iii. p. 324). Hulke, in dissecting a disorganised and irritable eye, found a cysticercus between the choroid and retina.

[2] A case of cysticercus in the vitreous humour is related by Desmarres, *Traité théorique et pratique des Maladies des Yeux*, 2nd edit. 1858, vol. iii. p. 756. Another by Williams in the *Cincinnati Lancet and Observer*, May 1858. See Liebreich's *Atlas*, tab. vii. figs. 5 and 6.

fixed, the spots appear to sink slowly downwards, just as filmy particles would sink in a liquid which had been shaken and then allowed to rest. A sudden turn of the eye will again cause the little bodies to disperse for a moment, and when the eye is once more fixed, they slowly descend as before.

So long as the patient steadily concentrates his attention on any external object, the *muscæ* are not seen; but if he accidentally catches sight of one of them, the whole field of vision at once becomes crowded with them.

The best way of examining the floating bodies is for the patient to look directly downwards upon the illuminated field of a microscope. They will then be recognised as beaded filaments, variously twisted and bent; sometimes appearing as loose knots of coiled-up fibres entangled together. When thus grouped they have a greyish colour, but when a single filament is examined it is seen to be made up of highly-refractive globules, varying in form and size. Sometimes a filament may be seen to bend, and again become nearly straight, or to turn in such a manner as to present itself in a foreshortened position. This latter circumstance proves that the bodies float freely in a fluid, and are not situated, as some have supposed, upon the surface of the cornea. This is still further proved by the fact that the blinking of the lids has no effect whatever upon the position of the *muscæ* in the field of vision. If, when the lids are closed, the eyes are turned towards a strong light—exposed to sunlight, for instance—the *muscæ* can still be seen, and their movements will be just as free as when they were observed with the eyes open.

Some interesting experiments were made on himself by Mackenzie,[1] to determine the seat of *muscæ volitantes*; but the most conclusive researches as to their nature are those by Jago,[2] who has satisfied himself that these disquieting spectres are, in fact, nothing more than the beaded filaments of the vitreous body itself. The normal network of these filaments, he says, can be seen by any one who knows how to look for them—under certain conditions, I presume, of impressibility of retina. Those filaments which, from being tangled together in irregular masses, form such annoyances to the patient, would appear to be the filamentous network in a disintegrated state.

There are few phenomena which give rise to more alarm in patients' minds than *muscæ volitantes*. A vague notion that they are the forerunners of amaurosis or cataract is almost universal; and even medical men are apt to confound these *floating muscæ* with the moving cloudy shadows resulting from effusions of blood or lymph within the vitreous humour, or with the fixed spots betokening that some limited portion of the retina has become insensible to light. A careful attention to the appearances of the *muscæ volitantes*, as I have described them, will enable the patient to convince himself of their real nature; and the surgeon may console him with the assurance that, although incurable, they are perfectly compatible with excellent and enduring sight.

CHAPTER X.

DISEASES OF THE LENS AND CAPSULE.

In a state of health the lens and the membranous capsule enclosing it are perfectly transparent. In early life they are also quite colourless; but after the age of thirty the lens in most persons begins to assume a pale yellow tinge; and this gradually becomes more marked as age advances, until in old subjects it frequently acquires the colour of amber.

Any loss of transparency in the lens, whether affecting the whole or only a

[1] First in the *Edinburgh Med. and Surg. Journal*, for 1865; and again in his *Practical Treatise, &c.*, 1854, p. 951.

[2] *Entoptics, with its uses in Physiology and Medicine*, 1864, p. 93.

portion of it, constitutes *cataract*; and in strictness this term should be limited to changes in the lens and its capsule. To call an opaque inflammatory effusion in the area of the pupil a 'spurious cataract,' is to introduce a loose and uncertain terminology, which can only give rise to confusion in our descriptions of disease.

Abnormal position of the lens.—The 'suspensory ligament,' which is attached to the capsule all round the margin of the lens, maintains it in a fixed position. A blow on the eye sometimes ruptures a portion of this ligament, and allows the lens to become tilted backwards and forwards. If the ligament is detached to a considerable extent, the lens sways to and fro with every movement of the globe, and vision is much confused. Eventually, under such conditions, the lens becomes opaque; but I have seen cases in which it remained transparent for a very considerable time.

It appears that the suspensory ligament is liable to a congenital defect, whereby the lens, instead of maintaining its normal position, undergoes displacement in a lateral direction, so that its centre no longer coincides with the centre of the pupil. A curious instance of this malposition of the lens occurred in a mother and three children who came under my care. In the mother, and in one of the sons, both lenses were displaced upwards and inwards; in another son, directly inwards; and in the third, directly upwards. In none of these cases did the lenses deviate, or only in the slightest possible degree, from their normal transparency.

[This condition is not very infrequent. In some instances the refraction through the lens is myopic, whilst refraction through the interval between the edge of the lens and margin of the dilated pupil is hypermetropic, which causes much confusion of sight in subdued light. As observed by Mr. Dixon, it often affects several members of a family, and it is hereditary.—J. W. H.]

Cataract.

This term, as I have already observed, should be strictly limited to denote partial or complete opacity of the lens.

The expression capsular cataract has of late years been objected to, because the capsule itself never becomes opaque; we, however, retain it, because we cannot in practice distinguish between opaque accretions upon the surfaces of the capsule and the membrane itself.

Opacities of the lens appear to be due to molecular degenerations of its tissue, induced by impairment of its nutrition. The causes of cataract, whether remote or proximate, have hitherto received no satisfactory explanation. The fact that the lens may be opaque at birth, or may become so in old age, at once proves under what widely different conditions the disease is developed.

In all countries, cataract is a frequent accompaniment of advancing years; and neither social position nor peculiarity of employment exempts the aged from being liable to it.

The surgeon must constantly be on his guard against being too much impressed with the mere existence of opacity in the lens, as if it were altogether an independent disease.

Various inflammatory conditions of the eyeball may eventually produce cataract, but in such cases there are usually some signs of disease in other tissues, as well as certain peculiarities in the position or appearance of the lens itself. Old adhesions between the pupillary margin and the anterior capsule—a bulging forward against the cornea of the iris and lens, or their receding too far backwards, so as to produce an unnaturally large anterior chamber—an irregularly dilated and fixed pupil—a tremulousness of the lens whenever the recti muscles are put in action—total loss of perception of light—such are the more striking conditions which at once would lead us to institute searching inquiries into the earlier history of the case, or to regard the cataract as unsuited for operation.

Classified according to the time at which they appear, cataracts are congenital, infantile, and senile; in relation to their cause, they are traumatic and idiopathic;

with reference to their consistence, hard and soft; and in respect of the seat of the opacity, they are cortical, intermediate, and nuclear.

The reader need not be detained by a long account of the *subjective* symptoms which attend cataract; for the detection of the disease depends wholly upon a careful examination of parts lying open to our observation. A full detail of subjective symptoms is, no doubt, very useful in ascertaining the morbid condition of a structure wholly concealed from our view; but this is not the case with the lens, and if we suspect opacity to exist, we have simply to look for it.

It must always be remembered that simple opacity of the lens, however far advanced, never deprives a patient of perception of light, provided the retina is sound. Indeed, in the great majority of instances, a patient with no other disease in the eye but an opaque lens, will not only readily perceive the shadow of a hand, or other object, passing between him and the sky, but, with his back to the window, will perceive the light reflected from a sheet of paper, although he may be quite unable to detect the form of the reflecting surface. Many patients, with densely opaque lenses, will, in the same position, recognise well-illuminated coloured surfaces, such as bright red or yellow, or will even discriminate between yellow and white.

A more or less marked dimness of sight, uniformly involving the field of vision—coming on gradually, and without inflammation, unattended with any impairment of motory power in the iris—such would be the symptoms which would make us suspect the existence of cataract. Our examination should be conducted in the following way:

The patient should be placed close to a window admitting bright daylight—not direct sunlight—and care should be taken that the light does not fall upon the cornea from more than one window, and that reflections from mirrors and other polished surfaces do not interfere with the single ray which should pass into the pupil. A convex glass of an inch focus should be used as a condenser, to concentrate light upon the surface of the patient's lens, while we explore it with the naked eye. In this manner faint streaks of opacity may be detected, which would otherwise escape us. Each eye must be separately examined.

The pupil having been fully dilated *with atropine*, we repeat our examination as before, with the aid of concentrated daylight, carefully illuminating and exploring the extreme margin of the lens, and, if its body be sufficiently transparent, lighting up and examining its posterior surface. In this manner the faintest streaks of commencing cataract may usually be detected; while dense patches along the margin of the lens, opaque striæ converging along its anterior or posterior surface, delicate lines radiating from the centre or the uniform haze of a cloudy nucleus, can hardly escape detection.

These examinations should be controlled by the direct method of ophthalmoscopy with the precaution of using a very subdued illumination. In most cases, the opaque striæ of a commencing cataract are then seen as radiating black lines, while a hazy nucleus assumes the appearance of a dark cloud in the centre of the pupil.

While cataract is still in a very early stage of development, it is so important to ascertain the condition of the retina and choroid, that in every case the ophthalmoscope should be used to complete our diagnosis.

By examining the deep tissues we sometimes detect in them morbid conditions, which would induce us eventually, when cataract had become complete, to abstain from operating; or, if an operation were deemed desirable, it would be undertaken on the full understanding that only partial success would be attainable.

CONGENITAL CATARACT.

This opacity may exist in very different forms.

1. The slightest form is that of a small white central dot on the anterior face of the lens (*Cataracta centralis*). This dot consists of a minute portion of earthy matter deposited in the most superficial portion of the lens, just within the capsule. In cases of this kind the rest of the lens commonly remains throughout life trans-

parent, and the patient is often unconscious of any defect of vision. Occasionally, however, a few faint white lines are seen radiating from the central dot. If the rest of the lens remains transparent, this slight form of cataract should by no means be treated by operation.

2. Sometimes, instead of forming a minute central dot, the opacity is so large as to occupy nearly the whole area of the pupil, when in its contracted state. It projects forwards in the shape of an obtuse white cone, and appears to adhere by its base to the anterior surface of the capsule. This, however, is not really the case, the cretaceous mass being imbedded in the superficial portion of the lens, and covered by the transparent capsule. The term *Cataracta pyramidata* has been given to this congenital form.

3. Another form of congenital cataract is that in which the nucleus is opaque, while the peripheral portion remains transparent. In the contracted condition of the pupil this transparent portion is hidden by the iris, but it comes into view when the pupil is widely dilated. In the contracted, or but slightly dilated, state of the pupil, its entire area is occupied by a greyish-white opacity. When inspected with the ophthalmoscope by the direct method, the opacity appears equally dense throughout, or is denser centrally than at the periphery. When the pupil is widely dilated with atropine, this opacity is seen to be surrounded by a perfectly black area, and through this clear ring-shaped space the patient has tolerably clear vision. Those who examine such cases for the first time are apt to imagine that the opaque nucleus which they see really constitutes the whole lens, shrunken and contracted to an unnaturally small size, and that the dark ring-shaped space is altogether unoccupied by lens-tissue. Occasionally a few white lines are seen to traverse this space, passing from the opaque nucleus to the outer margin of the lens. When such a nuclear cataract is broken up with the needle, in the operation for solution, the real nature of the case is made manifest, and the peripheral portion of the lens soon becomes as opaque as the nucleus itself.

If cases of this kind are not operated upon in early life, the patients, although very short-sighted, continue for many years to enjoy considerable powers of vision; but usually, towards the age of forty, if not sooner, the peripheral portion of the lens undergoes a change, and gradually becomes opaque.

4. A form of congenital cataract, much more rare than that just described, consists of a very faintly-striated opacity of the nucleus, unaccompanied by that chalky-white central patch which renders the ordinary congenital cataract so conspicuous and so easy of diagnosis. Several instances have come under my notice, in which this rarer kind of cataract has remained undiscovered until the patients were of an age to be sent to school, when their inability to read ordinary type has caused their friends to seek advice.

5. A very common form is that in which the nucleus and the cortex of the lens are transparent and the opacity is limited to an intermediate zone. Occasionally, more than one such zone is present. Cortical striæ are sometimes noticeable at the periphery of the lens. In the direct ophthalmoscopic examination the maximum opacity will be found at the circumference of the opaque area, and not at the centre. This form is known as Lamellar cataract.

6. It is very unusual to find cataract first commencing between infancy and puberty; but I have met with a few cases in which the opacity seemed to have begun when the patients were about nine or ten years old. They had been sent to school at the age of seven or eight, and had readily learned to read; but at the end of a year or two their sight began to fail, they became at first short-sighted, and then gradually lost the power of reading any but large type, or of recognising faces across a room.

I have observed two distinct forms of opacity in these cases.

In one form the lens was dotted throughout with minute white points arranged in the course of its fibres. These dots were as small as if pricked-in with the finest needle, and the general effect they produced was that of a very faint haziness in the pupil, only recognisable under concentrated light.

In a second set of cases the opacity was wholly confined to the posterior surface of the lens. In some instances there was one isolated patch in that situation, not exactly in the axis of the lens, but reaching from near that point to its extreme edge. In other cases the whole posterior face was covered with very fine opaque lines, closely set together, and converging from the circumference to the centre, so as to produce the effect of a delicate fibrous membrane of concave form. Encircling the exact centre of this opaque surface was a whitish ring, more dense and earthy in appearance than the rest of the striated surface of which it formed a part.

These opacities, limited to the posterior face of the lens, of course require for their detection far more careful observation than congenital cataract of the ordinary kind, in which the whole nucleus is opaque, and the centre probably marked with a chalky-white patch in the very centre of the pupil.

Congenital cataract, whatever form it may assume, is frequently accompanied by a rhythmical twitching movement of the eyeballs, the effect of irregular action either of the recti or the oblique muscles. This twitching is known by the name of *nystagmus*. It does not, however, invariably accompany congenital cataract, some patients suffering from this affection being entirely free from any irregular muscular action; while, on the other hand, *nystagmus* is met with in many cases of defective sight wholly unattended by any opacity of the lens.

There are certain morbid deposits in the deep tissues of the eyeball which in infants and children may be mistaken for the opacity of cataract. Tubercle and glioma, for instance, in their early stage, are not unfrequently mistaken in this manner by very inexperienced persons; but a careful examination through a well-dilated pupil cannot fail to detect the real nature of the disease. Both tubercle and glioma have a more or less yellow colour, and by a practised observer will be recognised as lying much farther back the hinder surface of the lens. At a certain stage, however, of tubercle in the corpus vitreum and glioma the lens becomes cloudy; and how, it may be asked, is a secondary cataract of this kind to be distinguished from one which is primary, and unconnected with any other affection of the globe? In an eye affected with simple cataract the position of the iris is usually vertical, or nearly so; the pupil is active; the lenticular opacity is regularly striated, and perhaps exhibits also at its centre a white dot. In advanced tubercle and glioma, on the contrary, the anterior chamber is obliterated, the pupil is irregular, dilated, and fixed; the lens has an uniformly cloudy appearance, and sometimes receives from the mass behind it a somewhat yellowish tint. Congenital cataract, too, almost invariably affects both eyes; while glioma almost as invariably occurs in one eye only. Tubercle does, indeed, occasionally affect both, but rarely to the same extent, or at the same time.

In children and also in older persons who have been brought under my notice for congenital cataract, I have been struck with the frequent occurrence of diseased teeth; the incisors and canines being dwarfed, deficient in enamel, discoloured and honey-combed on their anterior surface, and their cutting edge worn away and blunt I am unable to offer any explanation of this condition of the teeth, which I do not find mentioned by any ophthalmic observer. [Attention has been called recently by several observers to this association; but its exact nature must be regarded as still unsolved.—J. W. H.]

CATARACT IN ADULTS.

Except as a result of injury, cataract is rarely seen to commence between puberty and the middle period of life. Up to the age of forty it is a rare disease, it becomes more common in patients who have passed their fortieth year, but it is after the age of fifty or sixty that we are more especially on the watch for it in patients complaining of failing sight.

Even up to extreme old age cataract usually commences at the circumference of the lens, in the form of opaque striæ, which gradually advance along the anterior and posterior faces of the lens towards its axis.

About the same time very fine whitish lines may be observed to radiate from the anterior pole of the lens, marking the divisions which exist between the planes

in which its fibres are arranged. After the age of sixty a hazy condition of the nucleus is commonly found co-existing with advanced marginal opacity; but even in extreme old age it is far more common, as I have already observed, for cataract to commence at the margin than at the nucleus.

If we trace the rise and progress of cataract in an elderly person, the changes will usually be found to occur in the following order. First, opaque striæ are formed at the extreme edge of the lens, and commonly it is the lower edge which is thus affected. These striæ gradually coalesce into patches, and then spread themselves over the posterior face of the lens, only a few extending a short distance over the anterior face. At this point of development the cataract may remain stationary for a year, or even for several years. Then a farther change takes place, and the whole body of the lens, but especially the nucleus, becomes slightly hazy, but not so as to prevent the posterior radiated opacity from being recognised when properly illuminated. The opaque striæ on the anterior face of the lens gradually advance until their tips appear within the area of the pupil. The haziness of the body of the lens increases until even concentrated light fails to reveal the posterior striæ, and at last only the anterior surface of the lens can be seen. At this stage of cataract, vision is restricted to mere perception of direct light, or of that reflected from white or polished surfaces. Perhaps bright colours may still be recognised.

Up to this point the fibrous structure of the lens can still be traced; but as years go on, its surface becomes more opaque and whiter, in consequence of disintegration of the superficial fibres, and the deposit among them of earthy and fatty material. Occasionally crystals of cholesterine, just within the capsule, may be recognised by their peculiar sparkling appearance.

Fluid cataract; Morgagnian cataract.—The softening process, which begins in the superficial portion of an opaque lens, may go until, in the course of years, the whole mass becomes converted into a thin pulp. The nucleus, for a long time, resists this softening change, and a lens consisting of a firm nucleus, surrounded by a turbid pulp of disintegrated tissue, has received the name of 'Morgagnian cataract.'

It sometimes happens that this final stage of superficial softening does not occur, and the cataract is then very difficult of detection without optical aids, having a dull brownish appearance like horn.

A very rare form of lenticular opacity is that termed 'black cataract.' The name is frequently given to lenses which are only of a dark-brown colour, but absolute blackness is sometimes met with. It must not, however, be supposed that in these cases the blackness of the pupil is like that presented by a healthy eye, in which all the humours are perfectly clear. In the two or three cases of black cataract which I have seen, there was not the slightest doubt as to the existence of a cataract, although the blackness, so remarkable after extraction, was not suspected; for, in each instance, several fine whitish lines could be seen radiating on the anterior surface of the lens, formed, no doubt, by slight earthy deposits just within the capsule.

It should be known that 'black cataract' is a popular German expression for amaurosis.

TRAUMATIC CATARACT.

The lens may lose its transparency in consequence of a blow on the eye, although the globe may not be ruptured, or the lens itself displaced from its connections; the mere shock apparently being sometimes sufficient to affect the nutrition of the lens, and induce a gradual opacity of its whole substance. Since, in some such cases, rupture of the capsule can be demonstrated, it probably occurs in all.

Any penetrating wound of the lens is sure to produce cataract, and if the wound in the capsule remains widely open, so as to allow the superficial cells and fibres of the lens to imbibe the aqueous humour, the whole mass gradually becomes disintegrated and absorbed, so that eventually a wounded lens may wholly disappear without any surgical interference. It was a knowledge of this natural process that

first suggested the operation for the cure of cataract by *solution*. It is only in exceptional cases that the whole lens becomes absorbed in consequence of a wound. More commonly it happens that a certain portion of lens-tissue remains enclosed within the capsule, and undergoes fatty change.

Dislocation of the lens into the anterior chamber.—This accident takes place as a result of external violence, such as a blow upon the eyeball or a violent fall. It more frequently happens when the lens has been long in an opaque condition, and its suspensory ligament weakened, or partially detached by disease. The appearance of an opaque lens in the anterior chamber is so peculiar, that the nature of the accident can hardly be mistaken. When the lens is dislocated in a transparent state, its margin presents the appearance of a ring of golden light. Pain and inflammation set in very soon after the occurrence of the accident, and loss of the eye can be averted only by prompt removal of the lens, through a suitable opening in the cornea.

I have already spoken of certain forms of partial displacement of the lens, when treating of the inflammation such accidents give rise to (see the section, ' Traumatic Iritis,' p. 53); and have considered ' subconjunctival dislocation of the lens ' in the chapter on Affections of the Sclerotic (p. 48).

Treatment.—Can cataract be cured without an operation? This question will be answered in the affirmative by quacks, who, for their own selfish ends, avail themselves of that shrinking from anything bearing the name of an operation which is a natural instinct in us all, and pretend, by means of liniments, or drops, or the still more scientific-looking galvanic battery, to turn opaque lenses into clear ones.

It would be presumptuous and absurd to pronounce absolutely that no cure for cataract, short of a surgical operation, can *ever* become possible. But certainly nothing approaching to such a cure has hitherto been discovered.

It must always be remembered that simple opacity of the lens, however far advanced, never deprives a patient of perception of light, provided the retina is sound. Indeed, in the great majority of instances, a patient with no other disease in the eye but an opaque lens, will not only readily perceive the shadow of a hand, or other object, passing between him and the sky, but, with his back to the window, will perceive the light reflected from a sheet of paper, although he may be quite unable to detect the form of the reflecting surface. Many patients, with densely opaque lenses, will, in the same position, recognise well-illuminated coloured surfaces, such as bright red or yellow, or will even discriminate between yellow and white. If, in addition to this perceptive power, the iris maintains its vertical plane, the pupil is round and active, the cornea brilliant, the consistency and movements of the globe perfect, the surgeon may regard the cataract as suitable for operative treatment.

Operations for Cataract.

These may be arranged under three heads,—*depression*, *solution*, and *extraction*,

1. In *depression*, or ' couching,' as it was formerly termed, the lens is thrust from its natural position down into the vitreous tumour behind the iris, in such a manner that, although still within the eye, it may allow the light to pass unimpeded through the pupil to the retina. This method of operating is quite abandoned.

2. The operation by *solution* or *absorption* grew out of that by depression; for it was found that, if, in the attempt to depress the lens, it accidentally became much broken up, the fragments gradually dissolved and disappeared.

3. In *extraction* the lens is lifted bodily out of the eye through a wound in the cornea.

Operation by Solution or Absorption.

I have said that this operation grew out of that by depression; and it is only surprising that some of the older surgeons, who had been struck by the manner in which fragments of the lens, accidentally detached during their attempts at

depression, became spontaneously absorbed, did not earlier discover that this principle of absorption might be applied to the removal of the whole lens.

When this principle began to be understood, surgeons fell into the mistake of supposing that the more completely the lens was broken up at first, the quicker would absorption go on; and they therefore endeavoured to cut up the whole lens into fragments, by what was termed the operation of *discission.*

The leading principle to be observed in all operations for the solution of a cataract is, not to oppress the eye with more broken-up lens-tissue than the absorbing power of the organ is capable of rapidly removing. If this rule be neglected, the numerous fragments act as so many foreign bodies; inflammation is set up in the iris and cornea, and then all absorption is at once arrested. The conjunctiva and sclerotic become injected; there is pain in and around the eyeball, with intolerance of light and lacrymation; the aqueous humour is turbid, and the epithelial surface of the cornea dull and uneven.

Operation on infants.—The breaking up of the lens, if carefully performed, is so devoid of danger that it should by no means be deferred on account of the tender age of the child; on the contrary, by operating early there is a greater probability of obviating those twitching movements of the globes (*nystagmus*) which so frequently attend congenital cataract. Of course, if the infant were extremely puny and ailing, affected with diarrhœa, or in any way weakened by temporary derangement of health, the operation should be deferred for a while, until the health has been restored; but it is desirable not to wait until the irritation of teething sets in.

The needle I prefer for most of the operations on the lens has a small lance-shaped head, and the relative proportions of the head and the shaft of the instrument should be exactly such as will allow of the shaft playing with perfect freedom in the aperture which the head has made. If these proportions are not accurately preserved, and the shaft is made larger, with the view of preventing the escape of the aqueous humour, it becomes wedged in the wound, and all movements of the point are difficult and constrained. A needle of a larger size than that used for the ordinary operation on infants is very useful in breaking up the capsular obstructions which remain after the lens-tissue has become absorbed, as the head may be of such a size as to allow of its convex edges being made to cut.

All cataract operations are best performed on patients lying down. Infants are best secured by swathing them from the chin to the feet in a round-towel. An assistant steadies the head by placing a hand on each side of it; the lids are kept apart with a spring speculum, and sometimes it becomes necessary for a little fold of the conjunctiva, close to the cornea, to be nipped up in a forceps, so as to steady the eye. If the operator contents himself with using a single needle, he can himself with the other hand use the forceps; but if he prefers a more complete laceration of the lens by the use of two needles at once, which is not advisable, he must of course entrust the forceps to the hands of a second assistant.

Previous to any needle-operations for cataract, the pupils should be dilated with a few drops of solution of atropine, applied an hour or so before.

The needle is to be introduced through the cornea[1] close to its junction with the sclerotic, and carried on until its point reaches the centre of the pupil. Then the anterior capsule is to be freely lacerated in various directions, and the body of the lens broken up.

If two needles are used together, the first should be passed in until its point reaches the middle of the pupil, before the second one is introduced through the cornea.

In an infant with congenital cataract both eyes may be operated upon at once; but in an adult the worse eye, if there be any difference, should be operated on first, so as to leave the patient one partially useful eye, while the process of solution, with the temporary loss of sight which it involves, is going on.

[1] I am assuming that all operations for solution of the lens, and for removal of capsule, are to be performed by *keratonyxis.* Formerly the needle was always passed through the sclerotic (*sclerony xis*); but the operation through the cornea, allowing, as it does, the point of the instrument being always kept in view, is evidently to be preferred.

After the operation both eyes should be kept closed by means of a light bandage, or strips of plaster on the eyelids, for twenty-four hours, by which time the little wounds in the cornea will have closed.

If the lens has been effectually broken up, and the infant is in good health, a few weeks will sometimes suffice to insure the absorption of the entire cataract; and the capsule, gradually retracting towards the periphery, will ultimately form a white ring almost or altogether concealed by the iris when the pupil is contracted.

But it is not always possible to effect this complete dispersion of the cataract by a single operation, and the capsule, enclosing between its layers a certain amount of unabsorbed lens-tissue, remains as a chalky-white disk, blocking up the pupil and preventing all useful sight. In such cases two needles must be employed, and the central portion of the opaque membrane torn through to the desired extent; or, in some cases, it may even be necessary to introduce the forceps through an opening made in the cornea, and extract the capsule. This latter proceeding, however, should never be resorted to if a good central opening can be effected by means of the needles only; for, in spite of every precaution, the pupillary edge frequently becomes adherent to the wound made for the introduction of the forceps; or else the traction of the iris, to which the capsule often adheres, causes subsequent distortion and deformity of the pupil, besides its tendency to lacerate the iris and provoke inflammation.

Operation on children and adults.—The cataracts which come before us in children, and in persons under thirty years of age, are very commonly those of the congenital form, which had been overlooked during the period of infancy. For it is rare to meet with instances in which cataract *begins* to be developed in childhood, or in the early years of adult life. The operation for the solution of cataracts of this kind is the same as that I have just described on the infant, with this important exception—that in the older subjects we must take care not to set up irritation in the eye by too extensively breaking up the lens at first; least of all must we be indifferent to the risk attending the accidental displacement of the lens into the anterior chamber, an occurrence which, as I have said, may happen in the infant without any bad results.

In the first operation on an adult, the surgeon should not do more than freely break up the anterior capsule to an extent equal to the area of the pupil when not under the forced dilatation of atropine, and disintegrate the superficial portion of the lens, without disturbing the nucleus. This may be done with a single needle, the spring speculum being used or not, according to circumstances. When aided by a skilful assistant, the surgeon may often dispense with the speculum; but it is usually more convenient to employ it, and its use will enable the surgeon to perform the operation alone, if no assistant is at hand.

In using the needle, the surgeon is always to begin to act with the point upon the central portion of the lens; and in all subsequent operations he is to work from the centre.

If, instead of beginning to attack the lens at the centre, the surgeon uses the needle at random, and breaks up the lens at the circumference, he will probably set loose some portions of capsule, which will afterwards wave to and fro in the pupil, and be a most serious impediment to the final success of the case.

After the operation both eyes must be kept closed for twenty-four hours, at the end of which time the needle-wound is usually united, and the aqueous chamber refilled. From the second day it will only be necessary to close the operated eye, and after a few days a shade may be substituted, and then that may be laid aside for a pair of tinted glasses. The day after the operation atropine should be reapplied, and its use continued so long as any sclerotic redness remains, or so long as the swollen and macerated lens threatens to press upon the iris. Day by day the white flocculent lens-tissue continues to pass through the opening in the capsule; and if the pupil is not kept well dilated, so as to make room for the increasing bulk of the lens, the iris will become inflamed, and pain will be set up in the eye

No absolute rule can be laid down as to how often and at what intervals it will

be necessary to repeat the needle-operation. In exceptional cases I have known a single operation suffice for the total absorption of the lens even in an adult : and in a healthy infant, after completely breaking up the lenses, I have seen both of them wholly absorbed at the end of two months. More commonly, it is necessary in children and young persons to repeat the disintegration of the lens a second time, at an interval of some months after the first operation, and a finishing touch with the needle may subsequently be required thoroughly to clear the pupil from capsule. It is important not to be premature in performing this final operation on the capsule, for during the process of absorption it undergoes so many changes of position by shrinking, that time should be allowed for it to settle into its permanent position before the final laceration of it is made.

It sometimes happens that, either on account of the lens having been too much broken up at once, or in consequence of the absorbing power having been checked by inflammation, the eye becomes oppressed by the displaced fragments of lens ; the sclerotic and conjunctiva then become injected, there is intolerance of light and profuse lacrymation, the iris becomes discoloured, the aqueous humours turbid, the cornea hazy and uneven on its epithelial surface. When these symptoms set in, the eye will be lost by inflammation, unless it be forthwith relieved from the pressure of the swollen lens. The lids being separated with the spring speculum, and the globe steadied with a forceps, an incision is to be made in the cornea not too close to its margin, lest the iris prolapse, and through this a small scoop or spatula is to be introduced into the anterior chamber. The softer pulpy portion of the lens will then escape along the groove of the scoop, or by the side of the spatula when it is rotated, or it may be sucked out through a tube ; and if this operation has been resorted to in time, an eye which had presented all the phenomena just described may be speedily restored to a healthy state, and that portion of the lens which has been left *in situ* will steadily undergo complete solution.

When a perfectly *fluid cataract*, or one which has to a very great extent undergone the fluid change, is operated on with the needle, it almost invariably happens that distressing nausea and violent vomiting set in immediately ; and in some cases I have known this state of sickness, attended with intense neuralgia, to continue for twenty-four or thirty-six hours. As soon as the capsule is punctured with the needle, a puff of creamy fluid takes place into the anterior chamber, and a farther escape of this fluid conceals the iris from view. If nothing farther is done, the distressing sickness is almost sure to set in ; but if the surgeon gently withdraws his needle, and immediately introduces at the same spot a broad cutting-needle, or the point of a cataract-knife, and rotates the blade, the whole of the milky fluid is evacuated, and the sickness is wholly or to a great extent averted. The nausea is best combated by allowing the patient frequently to swallow small fragments of ice ; and the neuralgia in the ophthalmic division of the fifth nerve will probably yield to the application of chloroform liniment, applied by means of lint to the forehead and temple.

Operations on opaque capsule.—It sometimes happens that, in breaking up a cataract with the needle, the capsule is so effectually lacerated, that it retracts sufficiently to leave the area of the pupil unobstructed ; but these are exceptional cases, and usually, after the lens-tissue has been wholly absorbed, there remain some portions of opaque capsule, which must be removed before the cure can be considered complete.

Capsular obstructions are likewise met with after extraction of the lens ; and it seems desirable, therefore, to defer the consideration of them until the operations of extraction have been described.

OPERATION OF EXTRACTION.

The solution and absorption of a cataract in an old person is an extremely slow process, partly on account of the density and impermeability of the nucleus of the lens, and partly in consequence of the diminished activity in the interchange of

material which characterises the tissues of the body in old age, so that discission is now never practised in old people, in whom a little more rapid removal of the opaque lens, therefore, becomes desirable; and the surgeon will find it preferable, in patients above thirty years old, to have recourse to extraction.

We may group the various forms of extraction under the heads: *Flap-Extraction*, *Peripheral-linear-Extraction*, and *Scoop-Extraction*.

The objects to be kept in view are the following:—

To make a crescentic opening in the cornea sufficiently large to afford an easy exit to the lens. Freely to lacerate the anterior capsule, so as to allow of the lens readily slipping through the rent when pressure is made on the globe. Lastly, to apply this pressure in such a manner that the lens may be made slowly to turn on its transverse axis, and thus to present its upper margin first at the pupil, and then at the corneal wound.

The pressure must be regulated with a nicety which is hardly possible unless the operator has the eyeball under his sole management. The best position for the patient, therefore, is to lie upon a high couch, with his head alone slightly raised.

The patient being placed in the manner described, the surgeon, standing or sitting behind him, raises the upper lid, placing his fingers against the very edge of the tarsus, so as to prevent eversion. An assistant draws the lower lid downwards, and keeps it fixed by making pressure against the malar bone. He must take especial care to do this, and not in the slightest degree to press upon the eyeball. The surgeon may control its movements by allowing the tip of one finger lightly to touch the sclerotic just above the cornea, while the other rests, as lightly, against the inner side of the globe. To do this safely requires the greatest tact and care; for, as soon as the knife has transfixed both sides of the cornea, all pressure must cease, and it ought at no time to be greater than will just suffice to enable the surgeon to make his puncture and counter-puncture with certainty. Firm pressure, kept up till the section is completed, will almost inevitably cause the lens to be violently ejected, with a gush of vitreous humour. Instead of this, it has now become customary to separate the eyelids with a speculum, and to steady and fix the eyeball by seizing with a forceps the conjunctiva and underlying fascia close to the cornea, near the point of counter-puncture.

The point of the knife is to be introduced on the equator of the cornea, a short distance in front of its junction with the sclerotic, carried steadily across the anterior chamber, and brought out at the corresponding spot near the inner margin of the cornea. During this thrust the edge is directed towards the upper margin of the cornea, so that, when the section is completed, a semi-lunar flap results.

The surgeon must take care to give the knife a steady onward pressure, so that the blade may constantly fill up the wound it is making. The utmost care, however, will not always avail to prevent the loss of aqueous humour; for so ready is the fluid to spurt out, that, if the sides of the knife be unevenly ground, sufficient space may exist between the blade and the edges of the wound to allow of the escape.

When this has occurred, if the iris should fairly come over the edge of the knife, the surgeon may disengage it by drawing the point of one finger over the cornea, from below upwards, and then making a little pressure directly backwards. In this way the iris may be made to slip back behind the edge, and by keeping up careful pressure until the section is nearly completed, the iris may be prevented from coming forward again.

The operator may find it impossible wholly to disengage the iris from the knife, and a portion of the upper margin of the pupil may be cut away. This of course causes a slight bleeding into the anterior chamber, which obscures a view of the parts during the next stage of the operation, but the lens usually escapes readily through the artificially enlarged pupil, and, except the deformity, no permanent bad result necessarily follows the accident. Sometimes, however, it happens that a *fold* of the iris is cut through, so that there results a hole in the iris just above the true

pupil. When this occurs, the surgeon must at once divide the strip of iris between the two apertures, so as to lay them into one before he proceeds to lacerate the capsule.

As soon as the corneal flap has been completed, if the speculum is not employed, and the patient is not under the influence of an anæsthetic, the upper lid is allowed gently to fall, care being taken that it does not catch against the edge of the flap and evert it; and the surgeon proceeds to the second stage of the operation—the division of the anterior capsule.

After a short pause, he again carefully raises the upper lid, without making pressure on the globe, and surveys the wound. If he has made it too small, he must at once enlarge it, by passing a short, narrow, blunt-ended knife, or the blade of a pair of scissors, under the flap, to the outer angle of the wound, and carefully dividing the cornea close along its margin, in a downward direction.

No difficulty should deter the surgeon from making the wound sufficiently large before attempting to press out the lens; for if, while the opening in the cornea is too small, pressure be made on the globe, the hyaloid membrane will probably give way, and allow a portion of the vitreous humour to escape; and immediately the lens, instead of presenting itself at the section, sinks down into the space left by the lost humour.

When this occurs, the surgeon must at once desist from all pressure on the globe and pass in a fine sharp hook through the now gaping wound, and through the pupil, to the hinder surface of the lens, which must be drawn out as quickly and as lightly as possible. Sometimes it is better to pass in a scoop instead of the hook; but, whichever instrument is employed, it must be placed *behind* the lens, which is to be kept well pressed against the cornea, otherwise it will be driven still deeper into the vitreous humour.

If the surgeon has satisfied himself that the corneal wound is sufficiently large to allow of the easy exit of the lens—and for this purpose it ought to involve nearly half the circumference of the cornea—he next proceeds to lacerate the anterior capsule. The cystitome is slipped under the corneal flap, care being taken not to entangle the point in the iris; and when its curve is fairly in the pupil, the handle is rotated so as to bring its point against the capsule.

In tearing through the capsule, the surgeon should take care that the rents extend quite across the area of the pupil. This laceration of the capsule requires a careful eye and a light hand, otherwise the lens itself may be displaced.

The cystitome having been withdrawn, with due care against entangling it in the iris, the surgeon proceeds to the last act of the operation—the removal of the lens.

It is a fatal error to suppose that this removal is to be effected by main force; that the eye may be squeezed in any direction, if only it is squeezed hard enough. The real object of pressure is to make the lens first turn on its transverse axis, so that its upper edge may become tilted a little forwards. To effect this the convexity of the scoop is laid against the lower lid—which the assistant is not to touch during this stage of the operation—and gentle pressure is to be applied through the lid against the sclerotic, or directly on the sclerotic if the eyelids are held apart with a speculum a little beneath the lower margin of the cornea. With the forefinger of the hand which holds the upper lid, similar gentle pressure is made on the upper part of the globe, just above the section; and then, by a carefully-regulated alternating pressure on these two points, the lens is made slowly to turn and present its upper edge at the pupil. Coming in contact with the cornea, the edge of the lens is guided upwards, and begins to protrude at the corneal wound. It is evident that as soon as the widest part of the lens has passed through the pupil, the rest will be inclined rapidly to follow; and therefore, if the surgeon does not moderate his pressure, the lens will suddenly start forward, and will very probably be followed by a gush of vitreous humour. According to the size of the corneal wound, and the degree of superficial softening the cataract has undergone, will be the amount of soft matter the lens will leave behind in passing out of the eye. A small lens will perhaps escape entire through a large wound; while if the wound be small, and the lens

bulky and much softened on its surface, a considerable quantity of lens-matter will remain in the pupil and about the lips of the wound.

Quick union of the corneal wound, upon which so much of the success of the operation depends, cannot take place if any foreign matter be allowed to remain between its edges; all soft lens-matter, therefore, which may be sticking there, must be carefully removed with the scoop. The iris, which very frequently protrudes, can be best returned to its position by means of the small spatula. It is unwise to dip again and again into the pupil with the scoop for the purpose of removing every portion of soft lens-matter. The capsule cannot be removed by such means; and it is to this that the fragments very often adhere, and a too free use of the scoop is very likely to rupture the hyaloid membrane, and cause a gush of vitreous humour.

Provided the lips of the wound are in perfect apposition, and the iris in its proper place—which may be known by the central position of the pupil—the capsule, and any very small portions of entangled lens matter, may safely be left for future removal, after the wound is healed and all irritation passed away.

When a gush of vitreous humour takes place at the moment the lens passes, the surgeon must immediately close down the upper lid, lifting it over the wound by the eyelashes, so as to prevent the edge of the tarsus catching against the projecting flap of cornea. The lids must at once be closed with strips of plaster and a bandage.

Although cases in which a small quantity of vitreous humour has been lost may ultimately do well, a deformity of the pupil always remains. It is large and drawn up towards the wound, and the iris forming the upper margin of the pupil retracts, so as to disappear altogether.

In the foregoing description of the operation by extraction, I have noticed some of the accidents that are liable to occur: but there remains to be noticed one more dangerous than all others, namely, *hæmorrhage into the vitreous chamber.*

Although the corneal section may have been perfectly well made, and every due precaution taken, it sometimes happens that a gush of vitreous humour, usually of watery consistence, occurs at the moment the lens escapes through the wound Within a few seconds, or at the end of a minute or two, the patient complains of severe pain in the eye, and blood appears oozing from between the lids. This oozing does not take place until the whole cavity of the eyeball has become filled with blood. In some instances, the hæmorrhage sets in several hours after the operation. Some diseased condition of the deep-seated tissues must exist in all these cases—a change of structure in the vessels of the choroid, with or without serous effusion between it and the retina. I need hardly say that, in all these instances of hæmorrhage, sight is utterly lost.

A similar hæmorrhage sometimes follows the removal of staphylomatous projections of the globe. As soon as the prominent portion of the staphyloma has been cut off, the pent-up aqueous fluid and serum, and the diffluent vitreous humour, gush out at the wound; and this sudden removal of support from the enlarged choroidal vessels causes them to give way. In such cases, I have found the whole retina enveloping the large clot which had been forced out of the eyeball; a proof that the blood which had detached the retina must have had its source behind that structure, namely, from the vessels of the choroid.[1]

AFTER-TREATMENT OF CASES OF EXTRACTION.

The prevalent belief that all operations for cataract are likely to be followed by 'inflammation,' and that the great aim of the surgeon is to keep this down, is of course unqualified in the popular mind by any definite notion as to the nature of this 'inflammation,' why it arises, or what parts of the eye it involves; and many members of the profession, when commencing the study of eye-diseases, have equally vague conceptions of the subject. Let us, then, examine a little into what takes place in an eye after flap-extraction of cataract.

[1] I published two cases of this kind in the *Lancet*, 1845, p. 623.

The cornea has been divided, by a clean cut, to the extent of half its circumference; the aqueous fluid has escaped; the lens has been gently squeezed through the pupil; the iris is in contact with the hinder surface of the cornea, the cut edges of which are in exact apposition; the concave surface of the upper lid lies against the wound, and affords it support.

Within a few hours—provided the nutrition of the patient's body is in a healthy state—adhesion takes place between the cut edges of the cornea. As this adhesion becomes firm, the aqueous humour is retained; it once more fills the anterior chamber, and defends the iris from being pressed against the cornea. The slight irritation to which the iris had been subjected, by the passage of the lens through the pupil, passes off, and within a period longer or shorter, according to the constitution of the patient, the extra quantity of blood, which had been affording reparative material to unite the wound, ceases to be sent thither, and the cure is completed.

If the iris is entangled in the wound, a mechanical obstacle to quick union is thereby established, and union must take place by a slower process, effused lymph agglutinating the iris to the cut edges of the cornea, and then gradually drawing them together. If vitreous humour has escaped through the wound, its edges will be kept asunder for some time, but will eventually unite by adhesion.

The pain which not unfrequently sets in a few hours after an extraction is commonly of a neuralgic kind. The patient's nervous system has been excited by anxiety about the operation itself, or its result. Bleeding is sure to increase this neuralgia; while a due supply of digestible food, a small quantity of stimulus, or a narcotic, will at once arrest the neuralgia and prevent its recurrence.

Extraction of cataract is an operation performed on those who are past the middle period of life, and one naturally expects to find among them many of those conditions of feebleness and impaired function which are incident to old age. No doubt cases occur of an opposite kind, in which the patients are plethoric, over-fed, over-stimulated with alcohol. They require to be 'toned down,' and their circulation brought into a more healthy state, which should be done by regulating their plan of living for several months *before* the operation is performed.

As soon as an operation of extraction has been completed, and the surgeon has satisfied himself that the flap is in a proper position, he should at once close the eye, without permitting any such trials of the patient's sight as may safely be made after the removal of opaque capsule, or the formation of an artificial pupil.

A little square of linen is laid upon the closed lids of both eyes, and over this a little pile of cotton-wool, and the whole is then fastened down with a knitted bandage. Some surgeons also apply strips of plaster across the lids.

For some hours after the operation the patient should remain on the couch, comfortably supported with pillows. When in bed the best position is on the back; but this is by no means to be insisted on if it becomes irksome, or makes the patient wakeful. That position is the best which is the most comfortable, and likely to induce sleep.

A narcotic is sometimes needed on the first night; and in some persons, especially those accustomed to opiates, it may require to be repeated for several nights in succession; but such cases form the exception, not the rule. Loss of appetite is so apt to follow the use of these drugs, that they should never be given without manifest necessity. I always prefer tincture of hyoscyamus to opium, as being far less likely to cause discomfort the next day or to confine the bowels.

The patient is of course to be thoroughly waited upon, so as to be spared every unnecessary movement or exertion. Tapes passed round the wrists and attached to the waist are a useful check upon sudden movement of the hands during sleep.

A moderate dose of opening medicine, given a day or two before the operation, will obviate the necessity for teasing the patient with purgatives during the first few days succeeding it. Old and feeble persons, especially those with any heart-disease, are sometimes seriously prostrated by being purged on the second or third day after the operation, just when it is so important that the healing process should be steadily advancing.

As regards diet, patients should not be deterred from taking a nutritious meal a suitable time before the operation; and a moderate quantity of easily-digested animal food should be given on each following day. In respect of stimulants, it is impossible to lay down any absolute rule. Those accustomed to take wine, beer, or spirits, must by no means be wholly debarred from them at a time when the nutrient power of the body is called upon to form new material for repairing a breach of surface. In short, the surgeon's object must be carefully to regulate both food and stimulants according to the patient's previous habits; neither keeping him too high nor too low, but as near as possible up to the ordinary level of healthy vigour.

The daily cleansing of the lids requires caution. The lower lid and cheek are to be cleansed with warm water, but the upper lid is on no account to be touched, for under its shelter lies the corneal wound, sudden pressure on which would induce great suffering, and might even cause the slightly-formed adhesion of the flap to give way.

The progress of the wound towards healing is to be judged of by the condition of the lid, and the quality of the secretion. If the patient complains only of an occasional pricking, or a sensation of grit; and if this can be traced to the slight involuntary movements of the wound against the lid; if this uneasiness subsides day by day; if the secretion consists of tears alone, or is mixed with a little of the natural conjunctival mucus; and if the skin of the upper eyelid retains its healthy appearance, and is free from redness and swelling—the surgeon may entertain the best hopes that a good union is going on.

An increased feeling of grit in the eye, coming on after the lapse of three or four days, and perhaps attended with neuralgia, would lead the surgeon to suspect that the section had yielded, and that *prolapsus iridis* had occurred.

The most unfavourable sign is a bright redness and a swelling of the upper lid, which sometimes appear on the second or third day after the operation, attended with a yellow puriform discharge. These appearances are commonly ushered in by a restless night, with headache and considerable depression both of body and mind. When the lid is raised, the ocular conjunctiva is found injected, and so œdematous that it overlaps the corneal margin (*chemosis*). The cornea itself is throughout yellow and opaque, so that no trace of iris can be discerned through it; the wound is gaping, and filled with bulging iris. Eventually the whole cornea softens, the flap sloughs, and the eyeball shrinks.

I have now and then seen this hopeless state of things come on after an operation which had been perfectly well performed, and when the surgeon had every reason to expect a most successful result. In such cases there has probably been some degeneration of tissue in the vessels supplying the globe, and a weak condition of the heart itself.

The time that should be allowed to elapse after the operation, before the eye is examined, may vary according to circumstances. In a healthy patient, when there has been no pain in the eye, or other bad symptom, the wound may be found perfectly united as early as the third day after the operation. But, as a rule, the fourth day is quite soon enough for an examination; and whenever there has been any loss of vitreous humour, so that the healing process has been retarded, the fifth will be the earliest day on which the eye can be prudently exposed. Indeed, in an old or feeble person, a wound which on the fourth day is going on well, will be all the better for another day of rest; and it often happens that a premature exposure sets up irritation, and, if the union be not firm, favours the subsequent yielding of the wound and prolapse of the iris.

If redness of the upper lid, attended with puriform discharge, comes on within the first two or three days, the surgeon should examine the eye just so far as to obtain a view of the lower part of the cornea, and ascertain whether it is becoming infiltrated with pus: and this may be done without exposing the wound itself.

It would be impossible to detail all the appearances which an eye may present when first examined after the operation; but it may be useful to describe some of the leading points which present themselves, both in favourable and in unfavourable cases.

1. The cornea may be transparent, with the exception of a little hazy line along the edge of the wound; the aqueous humour may have been resecreted, and the plane of the iris vertical; the pupil being either clear and black, or filled with a flocculent mass of capsule and lens-matter, accordingly as the lens has come out clean, through a large wound, or has rubbed off some of its soft cortical substance in passing through a small one. Vision may extend to the recognition of large objects, such as the fingers of a hand; or, in consequence of the obstruction still remaining in the pupil, may be limited to mere perception of direct or reflected light. Some little redness of the sclerotic and conjunctiva will of course be present in every case, an additional supply of blood having been sent to repair the corneal wound.

The appearances above described are most satisfactory, and would encourage the surgeon to look forward to a successful result.

2. The eye may present all the foregoing appearances, with the exception of the iris being in contact with the hinder surface of the cornea. This absence of anterior chamber arises from one or other of the following causes; either the wound, although sufficiently united to keep the cornea in its proper curve, has not become so consolidated as to be perfectly water-tight, and the aqueous humour therefore escapes as fast as it is formed; or else this fluid, which seems to be chiefly secreted in the posterior aqueous chamber, may be so pent up there by the lens-matter filling the pupil, as to thrust the whole iris forwards against the cornea. In the former case, by keeping the eye closed for two or three days longer, and giving the patient a little more stimulus or tonic, the wound will become consolidated. In the other case, the iris will slowly recede as the lens-matter in the pupil becomes absorbed, but perhaps will not quite resume its vertical position until the capsule at a later period shall have been broken through with a needle.

It occasionally happens that, although the corneal wound, when examined on the fourth or fifth day, appears well united, it subsequently gives way a little at some point, and allows a small portion of the iris to protrude, so as to cause slight displacement of the pupil.

3. The eye may be found in the following state: the cornea clear, the section gaping, and blocked up with iris, the latter having prolapsed into the wound, after being adjusted at the operation, and no union between the two structures having occurred in consequence of the feeble condition of the patient. In these cases the parts on the fourth day after the operation may appear almost as if the wound had been just inflicted. Chronic inflammation is sure to be set up, and is often attended with neuralgia. In non-union of this kind, it is sometimes good practice to keep the eye uninterruptedly closed for five or six days after the first examination, provided the healthy appearance of the lids, and the absence of puriform secretion, give assurance that the healing process is advancing.

4. Still more unfavourable than the appearances above described are the following: in addition to a gaping section and prolapsus iridis, a cornea hazy throughout, so that the iris cannot be clearly discerned; the edges of the wound thickened, opaque, and creamy-looking; the sub-conjunctival tissue infiltrated with serum, and the conjunctiva itself reddened and elevated (*chemosis*).

These local changes have usually been ushered in with pain in the eye and head, restlessness, and depression. Extreme care is necessary to treat a patient under such circumstances. Narcotics will probably be required at night; of these hyoscyamus is the best, and bark and ammonia are almost sure to render good service in keeping up the appetite and restore vigour to the flagging circulation. The diet will require the most careful management, so as to insure a sufficiency of nourishment being taken without oppressing the stomach; above all, the regulation of the supply of stimulants —wine or beer—will demand much judgment on the part of the surgeon, so that the patient's powers may be raised and sustained, without causing irritability and subsequent depression. But it will sometimes happen, in spite of care and skill, that such cases as these will terminate in closure of the pupil, with wasting and softening of the whole globe.

Although it is so important, after the operation of extraction, to defend the

patient from strong light for several days, there is no necessity for closing shutters and drawing curtains closely round the bed, if the patient's eyes have been bandaged in the manner I have described. Very moderate shading of the room is then sufficient, and thorough ventilation is most beneficial; for due aeration of the patient's blood is essential to the healing process.

Prolapsus iridis.—If the corneal section, instead of uniting by adhesion, has undergone that slower process of closure which takes place when a portion of iris is interposed between the edges of the wound, the *prolapsus* continues for some time to be a source of irritation. It should not, however, be too hastily interfered with; for, in healthy subjects, it usually wastes and flattens down by slow degrees. Sometimes, however, instead of diminishing in this manner, it becomes distended into a little vesicle, in consequence of the accumulation of aqueous humour behind it. If the prolapsus fills up nearly the whole extent of the wound, the corneal flap may be tilted forward in such a manner as to form an obtuse angle with the lower portion, the base of the flap being marked by a transverse crease, extending quite across the cornea from one angle of the wound to the other. As the process of contraction in the prolapsed iris goes on, the edges of the corneal wound are gradually drawn together, the transverse crease disappears, and the natural curve of the cornea is eventually restored.

If, however, instead of diminishing, the prolapsus remains as a large and prominent vesicular projection several weeks after the operation, means must be taken to induce it to contract. In many cases it is sufficient to puncture it with a broad needle. The eye must then be kept closed for a day or two. Should the prominence reappear, it had better be snipped off and the eyelids closed with a compress.

Fistulous wound.—If a case be not well watched for several months after the operation of extraction, the wound may become fistulous. This is an extremely rare occurrence; so rare, indeed, as to be unnoticed by most of the authors on ophthalmic surgery.

These fistulæ of the cornea are likely to be overlooked, on account of their extreme minuteness; for their aperture is sometimes no larger than the section of a human hair, and the quantity of fluid oozing out is small in proportion. The fistula of course allows a constant escape of aqueous humour, and the anterior chamber becomes obliterated, the iris lying in contact with the cornea. This drain of aqueous humour, if unchecked, seems to exert some peculiarly exhausting influence upon the eye, for in all the cases I have seen in which fistulæ of the cornea had existed for several years, all useful vision had become extinct.

There are certain points connected with the operation of flap extraction which may seem to have required notice before the operation itself was described; but it appeared preferable to reserve them for later consideration, because they can be properly appreciated by those only who have already made themselves acquainted with the details of the operation.

Inasmuch as extraction is performed upon persons more or less aged, it must often happen that the constitution of such patients has been damaged by various forms of acute or chronic disease before they come under our care as the subjects of cataract; so that we cannot expect to find them by any means in as favourable a condition for undergoing an operation as those whom we are in the habit of treating for many other surgical affections. There are, however, certain conditions which would either wholly contra-indicate extraction of cataract, or would cause us to undertake the operation only after the most careful preliminary examination, and unusual precautions against the more pressing difficulties of the case.

1. Extensive heart-disease is of all complications the most unfavourable; for, by enfeebling the supply of blood to the peripheral tissues of the body, it lessens the probability of a quick union of the corneal wound.

2. Violent cough, if occurring in suffocative paroxysms, would also greatly imperil the success of the operation: partly by the unavoidable restlessness and frequent

change of posture, and partly by the straining and shaking of the eye, which may disturb the wound, and induce prolapsus of the iris.

3. Fat and flabby persons have much less reparative power than those who are thin. Dry and wrinkled, but still vigorous old people—such as are popularly termed 'wiry'—are of all others the best adapted to undergo extraction.

4. Mere old age does not contra-indicate extraction; for one occasionally meets with persons of advanced years whose bodily functions are performed with surprising regularity. Commonly, however, the reparative power of the cornea is impaired after seventy.

5. If cataract is equally advanced in both eyes, and both appear equally well suited for operation, ought we to extract both lenses at one sitting? On this question much difference of opinion exists. My own judgment is decidedly in favour of operating on one eye only at a time. We learn much by watching the progress of a case after operation, and often see how, by this or that precaution, or course of treatment, a difficulty or a bad result might have been avoided. We operate, for instance, on a depressible patient during very hot weather, and find him utterly overcome and prostrated by it, perhaps to such an extent as to induce non-union of the wound, or even partial slough of the cornea. Were this to occur after we had operated on one eye only, we should learn experience by the result, and take care to select a cooler season of the year for operating on the other eye.

Or our patient may have deceived us as to his previous habits. He may for years have been accustomed to take large quantities of stimulants, and our first operation may have failed because we had not kept up his reparative powers sufficiently by artificial aids. Having learned the truth, too late to save the first eye, we might be able, by adopting a different plan of after-treatment, to save the second.

Without unnecessarily multiplying illustrations, I may say that by operating on one eye at a time we secure to ourselves the advantage of making our first operation a means of invaluable instruction with respect to the second; while, at the same time, the effort of nature in repairing a single corneal wound is of course less than is required for the repair of a second wound of equal extent.

6. Ought we to operate when cataract is fully formed in one eye, while the other is either free from cataract, or only slightly impaired by its existence in an early stage?

Exceptional circumstances may make it desirable in such a case to operate on the cataractuous eye; but in the great majority of cases it will be proper to wait until cataract is fully established in the other. Of course, after the extraction of the crystalline lens, a convex glass becomes necessary, to compensate for that portion of the optical apparatus of the organ which has been taken away; and it is almost, if not quite, impossible so to adjust any mechanical aids as to make the operated and the unoperated eye work well together. Each eye, taken separately, may be good; but there is a want of harmony between them which can never be reconciled.

7. The last question to be considered is, whether any particular time of the year is to be preferred for the performance of extraction? As far as the mere operation itself is concerned, I know of no period being positively contra-indicated, except the extremes of hot and cold weather. Severe cold acts unfavourably on old people by retarding the circulation of blood in their capillaries; while extreme heat enfeebles the action of the heart, especially when it happens—as is so common in old age—that some organic change has already taken place in it. The only time which I systematically avoid for performing extraction is during the sultry weather which sometimes visits us in July and August.

But one has to consider not merely the operation itself; the period of complete repair and convalescence is equally important. It is of the utmost consequence that a patient who has gone through the confinement and the mental anxiety inseparable from so important an operation as that for cataract, should at the earliest possible period enjoy the invigorating influence of change of air; and nothing tends so much to prolong that condition of chronic ophthalmia, which sometimes follows extraction,

as too long a confinement to the sick-room. A few days of careful exposure to the fresh air during genial weather equally improves the eye and the patient's general health. It is, therefore, of importance so to time the operation that the period of convalescence may coincide with the finer season of the year; and this can only be done by choosing the spring and early summer for the operation: April, May, and June are, therefore, the best months to select for extraction, although the later summer months may be chosen, provided the weather be not sultry and oppressive.

LINEAR EXTRACTION.

This operation is a modification of that invented by Gibson.[1] He advised that *soft* cataracts should be freely broken up with a needle, and that after inflammation had subsided—in three or four weeks—a small incision should be made in the cornea, and the broken-up lens removed with a scoop. As the true principles which regulate absorption of a cataract in its natural position, when its tissue has been carefully broken into with a needle, became better understood, Gibson's operation fell into disuse. The fallacy of his procedure was revealed by the words 'after inflammation had subsided.' If by breaking up all the lens at once inflammation was set up, the proper practice would have been at once to evacuate the lens-matter which was the cause of the inflammation. Either do this, or adopt the slower, but safe course of only disintegrating the lens sufficiently to induce the absorbing process, without throwing the bulk of it into the anterior chamber all at once.

The late A. v. Graefe modified Gibson's operation[2] in the following manner. After having dilated the pupil with atropine, he made a straight vertical incision, two, two and a half, or three lines long, through the cornea, not at its margin, but about a line nearer its centre. Such a 'linear' wound, he remarked, would heal more readily than a flap wound, and would involve less risk of *prolapsus iridis*. But, on the other hand, a rectilinear wound does not gape, and it therefore requires more manipulation to evacuate the pulpy lens-matter. Through the wound he passed in a small fleam-shaped cystitome, and with it broke up the capsule and the substance of the softened lens. Then a scoop was introduced into the midst of the pulpy mass, the wound was made to gape, by pressing the instrument against its edge, and the broken-up lens-matter escaped along the groove.

'Linear extraction' was not proposed by Graefe as a substitute for the older flap operation. He considered it to be specially suitable to cases of fluid lens, the corneal wound being made about two lines long; or when the lens was almost of a pulpy consistence, rather a longer incision being then required. When the lens had retained the normal consistence of adult life, and still more when in old age it had acquired increased hardness, he considered the operation contra-indicated.

In consequence of these limitations of the operation being disregarded, and its being applied to cases of firm cataract, it fell into discredit.

Removal of cataract by suction.—In 1847 Laugier announced a quick and easy method of removing softened cataracts by suction; 'par aspiration,' as he termed it. He thrust a sort of cannula through the sclerotic into the substance of the lens, and then professed to draw out the contents of the capsule by means of a piston. A less dangerous mode of operating was soon afterwards proposed by Blanchet, who employed a cannula and syringe somewhat similar to Laugier's, but with the much safer modification of introducing the cannula through a wound in the cornea. Suction fell into disuse, until it was revived, under a much more delicate and skilful form, by Teale,[3] in 1863. With two needles he tore up the capsule; then made a small wound in the cornea, through which he introduced a flattened cannula, or curette, into the body of the lens. A flexible tube attached to the curette terminated at the other end in a mouth-piece, and the operator gently sucked out the softened

[1] *Practical Observations on an Artificial Pupil, with remarks on the Extraction of Soft Cataracts*, 1811.

[2] *Archiv für Ophthalmologie*, Bd. ii. S. 217, 1855.

[3] *Ophthalmic Hospital Reports*, vol. iv. p. 197.

lens-matter. A syringe has sometimes been substituted for the tube. The reader will at once see that this must needs be a very delicate proceeding, and that if a too great power of suction be employed, serious mischief to various tissues of the eye may ensue.

However applicable to the cataracts of adults suction may prove to be, it is quite uncalled for in the congenital cataracts of infants, except when time is a great object, and in the course of discission the lens swells much and provokes inflammation. As I have already observed (p. 89) a lens freely broken up, and even to a considerable extent displaced into the anterior chamber, does not at that early age set up irritation; and in a few months every trace becomes absorbed and disappears.

SCOOP EXTRACTION.

In many cases of cataract it is impossible to determine absolutely to what extent the softening process may have extended, and what amount of hard nucleus may still remain. It often happened, therefore, that the surgeon who had commenced the rectilinear operation in the belief that the whole lens was pulpy, found himself embarrassed by a firm nucleus of considerable size. The removal of this mass required so much mechanical interference, that the iris became bruised and injured, and also fragments of lens might remain behind the iris and set up the most serious irritation. These and other complications seem to have led Graefe to devise a mode of operation whereby the iris might be saved from injurious pressure, and at the same time additional room might be made for removing even a firm nucleus through a corneal wound smaller than that made in an ordinary flap extraction. The result of these attempts was the operation of scoop extraction.

And here I would observe that, whatever may be the final verdict which, after more extended experience, may await the operation of scoop extraction, its invention is wholly due to Graefe, who to a great degree has been deprived of the merit of having originated it.[1]

There is no doubt that one of the chief causes of failure after a well-performed flap extraction, is the occurrence of prolapsus iridis, and by the iridectomy proposed by Graefe all possibility of this was of course avoided. At the same time ample room was made for the removal of a large and solid nucleus, and through a less gaping wound than the crescentic incision of flap extraction. By the use of a scoop to draw out the nucleus, all pressure on the globe was rendered unnecessary.

Scoop extraction seems most suitable to those cataracts which are in an intermediate condition between the semi-fluid state which admits of a complete evacuation through a rectilinear incision, and the hardness of those in which little or no superficial change has taken place.

From the diminished risk of escape of vitreous humour, during scoop extraction, in consequence of the smaller corneal wound and the absence of pressure on the globe, the vomiting which so often follows the use of chloroform is of less consequence than in flap extraction; and therefore it may be administered in operations with the scoop, although in very quiet patients it may not be necessary.

The lids being well separated with a spring speculum, the surgeon fixes the globe, by nipping up a fold of ocular conjunctiva below the cornea. He then passes in a lance-knife at the upper edge of the cornea close to its junction with the sclerotic.[2] Next a forceps is passed in at the wound, a portion of iris seized, drawn out, and cut off. The cystitome is then used to lacerate the anterior capsule, which should be done to the full extent of the now enlarged pupil. Lastly, the scoop is insinuated behind the upper edge of the lens, and carried on until the end of the instrument has passed just beyond the lower edge. The entire lens is then gently drawn out.

[1] The operation was very fully described by him in the fifth volume of the *Archiv für Ophthalmologie*, pp. 158–173, 1859.

[2] In his first description of the operation, Graefe advised that the cornea should be incised at its outer edge; but the deformity, and other disadvantages resulting from an over-large and misshapen pupil, are better obviated by making the incision upwards.

This sliding of the scoop behind the lens is the act of the operation which requires the most care, for by rudely thrusting the instrument too much backwards, its point might be made to break through into the vitreous humour. The surgeon must bear in mind the convexity of the hinder face of the lens, and give to the scoop a corresponding curved sweep.

It will depend upon the degree of softening which the surface of the lens has undergone, how much pulpy lens-matter will remain behind after the nucleus has been drawn out. As much of this pulp as can be got away without risk of breaking into the vitreous humour should be removed; but provided no solid nodules remain, the surgeon need not be over-anxious to get out every particle of soft matter. Each re-introduction of the scoop tends in some degree to irritate the edges of the corneal wound, and there is always the risk I have adverted to of breaking through with the instrument into the vitreous humour. The corneal incision being left clear of any lens-matter, the bandage may be applied over both eyes, as after flap extraction.

On examining the eye for the first time, the surgeon will sometimes find that the whole, or nearly the whole, of the enlarged pupil is filled with a flocculent or pulpy mass; but provided the wound be united, and the cornea clear, this obstruction of the pupil need not disquiet him. All will in time become absorbed, or if any considerable quantity should eventually remain, it may be cleared away by the aid of two needles, used in the manner hereafter described.

In most cases the softened periphery of the lens is sufficiently opaque to be readily seen at the time of the operation; but it is sometimes so nearly transparent as to be very difficult of detection, and it only becomes opaque and strikingly visible two or three days afterwards.

Although, from what I have said, it will be seen that the two great accidents which attend or follow flap extraction, loss of vitreous humour and prolapsus iridis, may be evaded by a carefully performed scoop operation, let not the reader suppose that the latter mode is to be regarded as 'extraction made easy,' or that success is always to be looked for. Cases occur in which, after the most careful scoop extraction, infiltration and softening of the cornea take place; or a more chronic form of irritation ends in permanent opacity of a large portion.

Graefe's scoop operation with iridectomy has undergone several modifications. One consists in first performing iridectomy, then waiting till the corneal wound is healed, and the anterior chamber restored; and then, by a second operation, removing the cataract with the scoop.

Another modification is as follows. A crescentic incision of the cornea is made, and the lens removed, as in ordinary flap extraction. A forceps being then passed in at the wound, the iris is seized, drawn out, and cut off, just as in the operation for glaucoma; the whole being done while the patient is under chloroform.[1]

PERIPHERAL LINEAR EXTRACTION; MODIFIED FLAP EXTRACTION.

This operation, the latest form of extraction that emanated from the fertile invention of the late A. von Graefe, or one of its many modifications, is now generally preferred to the older flap extraction just described. It is frequently called 'modified linear extraction;' but, inasmuch as a considerable incision is made in the cornea, and the lens is brought out entire, by being pressed through the wound, the procedure certainly bears more resemblance to a flap extraction than either to the 'linear' or its 'scoop' modification.

The patient is brought under the influence of chloroform; the lids are separated with a speculum; and the eyeball is steadied by nipping up with a forceps a fold of conjunctiva below the cornea. The knife, which is long and very narrow, is made to pierce the sclerotic at about the distance of a third of a line from its junction with the upper and outer part of the cornea, so that the instrument, as it is thrust on, enters

[1] As much of the success of the scoop operation depends on the form of the instrument itself, I must bear testimony to the superiority of that invented by Mr. Critchett, to which he has given the name of 'vectis.' (*Ophthalmic Hospital Reports*, iv. 315, 1865.)

the anterior chamber quite at its marginal angle. Having got the point clear into the chamber, the surgeon thrusts it on for a short distance downwards and inwards, then lowers the knife into a horizontal position, and brings the point out in the sclerotic at a spot opposite to that of its entrance; the edge of the knife, which had been kept upwards, is now to be turned a little forwards, and the corneal section completed. The wound now lies under the still undivided conjunctiva; this is then cut through with the knife, so as to leave a little flap of the membrane loosely covering the wound.

The next step of the operation is to remove the upper part of the iris with forceps and scissors, to such an extent as may seem desirable; then the anterior capsule is freely lacerated with the cystitome. Next the curette is to be laid upon the lower part of the cornea, and pressed in a direction upwards and backwards, so as to induce the upper edge of the lens to present at the section, and as the lens slowly advances, its egress is to be aided by the curette being steadily carried upwards, with gentle pressure, over the surface of the cornea; and if portions of the soft periphery of the cataract become detached, they are to be helped on in their upward course by repeating the gliding pressure with the curette. To prevent the epithelial surface of the cornea from being abraded during these movements of pressure, Graefe advised that the curette should be made of vulcanite instead of silver.

OPERATIONS ON OPAQUE CAPSULE.

I have elsewhere alluded to the statements of Stellwag and others respecting the so-called opacities of the capsule (p. 82). Surgically speaking, it matters not whether the capsule, which remains in the pupil after various forms of cataract operations, be in its very substance opaque, or whether it be only coated with opaque material. It obstructs vision and must be removed.

After the lens has been got rid of by solution, the anterior and posterior portions of the capsule, which have been broken through at the centre, retract and form a white ring, which is often wholly concealed when the iris is in its natural condition, only becoming visible when the pupil has been artificially dilated. Sometimes a band or two may stretch across the pupillary area.

After extraction also, it commonly happens that the shreds of torn capsule form a delicate film, blocking up the pupil; and if any slight degree of iritis has followed the operation, this film may be made additionally dense and visible by exudation of lymph. Even when the area of the pupil looks black and clear, some months after extraction, the surgeon should endeavour to keep the patient in view: for perhaps at the end of a year or so a filmy membrane will be found stretching across the pupil, so delicate as to be detected only after the closest scrutiny, and with the aid of concentrated light; and yet the existence of this film will just prevent the patient being able to read. Short of this point all objects may be seen well, and yet, for want of tact and care in detecting this slight obstruction to vision, the surgeon may lose the credit and the satisfaction of having performed a first-rate operation.

In some instances, the film, which forms many months after extraction, appears to be produced by an opacity of the hyaloid membrane advancing towards the plane of the pupil after the lens and its capsule have been removed.

There are no manipulations which demand more judgment and care than those for removing capsular obstructions. The two chief points to be observed are: to make the aperture in the capsule central, so that it may correspond to the axis of vision; and to avoid isolating any portions by completely detaching them from the rest of the membrane. Loose shreds, when set floating by unskilful management, are ever afterwards a source of annoyance to the patient. Above all, the division of the capsule is to be made with the least possible disturbance of the vitreous body.

Every movement of the needle should have a definite object. It is useless to make random stabs and plunges at detached portions of capsule, in the hope of depressing them by some lucky hit; for their buoyancy will almost always cause them to return to their former position as soon as the needle is withdrawn. Delicate

bands, tightly stretched across the pupil, may be divided in the middle, and then each half will retract toward its fixed point, and leave the interval free.

When a single needle is employed to tear through a portion of capsule, it sometimes happens that the delicate membrane yields and stretches, instead of being torn, and, after each attempt, the surgeon is mortified at seeing it return to its former position. It is in such cases that it is so efficacious to use two needles at once, as suggested by Bowman.[1] There is hardly any filmy expansion, or hair-like band, that may not by this means be divided.

The lids being held apart with a spring speculum, the surgeon has both hands at liberty, and he separately introduces the needles through the cornea, until their points reach the area of the pupil. He then, according to the nature of the obstruction, either makes in the centre of the opaque membrane a small hole, and then enlarges it by drawing the points of the needle in opposite directions, or cuts, twists, or tears through some band or filament which had been holding together the margins of the pupil.

If the rules which I have said should guide the surgeon in effecting the absorption of a cataract be strictly adhered to, namely, to attack the lens at the centre, always working the needle steadily from that point towards the circumference, and to be satisfied with slow progress, without attempting to break up a large mass of lens at the earlier operations; and if he carefully avoids isolating and setting loose any portions of capsule, he will rarely find it necessary to employ any other instruments than needles for obtaining a perfectly clear pupil.

But if a case has already been unskilfully operated on, and the needle used roughly and without any settled aim, it may happen that the entire capsule containing some small remains of white lens matter has become crumpled up and rolled into an opaque mass, which is either moored in the midst of the pupil by two or three delicate bands, or is attached by a single filament, which allows the mass of capsule to float and sway to and fro with every movement of the eye. In such a case the entire mass of capsule must be extracted.

To effect this, an incision of suitable size is to be made through the cornea near its edge, and a forceps introduced, the points being kept closed until they have reached the capsule. This is then seized, and withdrawn by gentle traction, sufficient to make the retaining filaments give way.

The forceps used for this purpose must be so constructed that, when its points are separated, the iris will not fall between them. The cannula-forceps best fulfils this indication.

Far from having described in the foregoing pages all the operations which have hitherto been devised for the removal of cataract, my narrow limits, and still more a distaste for being a mere chronicler of minute differences of procedure, or abortive attempts at originality, have combined to limit my descriptions to those operations which have been approved of and practised by leading surgical authorities, or which have in some degree secured a reputation by retaining for a considerable period the confidence of the profession. A full account of all the cataract operations invented up to the present time, with a criticism of their relative value, would form a work almost as large as the present essay. I cannot, however, dismiss this most important subject of cataract without a few observations on the relative merits of the operations which are practised for its cure.

For cataract in children and young persons, solution of the lens by keratonyxis if performed with the careful precautions mentioned at p. 88, appears to me to be a nearly perfect operation. The natural curve of the cornea is preserved; the pupil remains central; in short, all the structures of the globe are left, practically speaking, in their natural conditions, except that the offending lens is gone. The treatment, it is true, extends over several months, although in infants I have seen all the lens absorbed at the end of a few weeks. But even to a young adult, what is the delay of several months, nay, in extreme cases of enforced caution in operating, what is

[1] *Medico-Chirurgical Transactions*, 1853, vol. xxxvi. p. 315.

the delay of a year, when good and lasting sight is eventually gained, compared with the patient's loss, when the surgeon, for the sake of a rapid cure, by his over-manipulation or his dangerous activity, calls up destructive inflammation in the eye he was anxious to save?

Sometimes, in the course of the most careful treatment by solution, a sudden disruption and displacement of the whole lens occurs; nothing but an immediate incision of the cornea, and removal of the irritating lens-matter, will then save the eye; but this accident seldom happens if proper precautions have been taken from the first.

With regard to extraction, all surgeons, I think, are agreed that, *provided all goes well*, the final result of a good flap operation is superior to that of any other procedure. In an eye where all the tissues are sound except the lens, such an operation, skilfully performed, with careful after-treatment until the cure is completed, is a real triumph of surgery, only to be surpassed, perhaps, by the result of an equally perfect operation by solution. But then comes the all-important question, Is all as likely to go well with the ordinary flap extraction as with some of its modifications, or with the scoop operation?

The one great source of trouble after a flap operation is prolapsus iridis. The surgeon may have done his part perfectly; his last look at the eye, before he puts on the bandage, may show him the iris in its proper position, with the pupil central, and the corneal wound in the closest apposition. For three or four days after the operation, the patient may be quite comfortable, and the eye hardly complained of; and yet when the surgeon makes his first examination, he may find the section gaping, plugged with a mass of iris, the pupil displaced, or even drawn into the wound. Speedy cure or a shapely eye are henceforth unattainable; and the operator must be content if the cornea retains its transparency, and the other tissues are not too far injured by tedious inflammation to allow of sight being ultimately restored by the formation of an artificial pupil.

I know that many surgeons, in discussing the perils incident to flap extraction, would put forward, as one of the greatest sources of danger, the largeness of the corneal wound, as involving loss of vitality in the flap or a slow process of opacity in it. But I do not think that either of these disasters is often caused by the mere length of the incision; and, on the other hand, a free opening in the cornea allows the lens to escape without bruising the edges of the wound, and, what is of still more importance, without leaving behind it any considerable fragments of its cortical portion. Now this latter circumstance is inseparable from every case in which a lens is forced to squeeze itself out through a small aperture. In doing so it must scrape off more or less of its substance, and either these fragments remain, to set up irritation in the iris, or to insinuate themselves into the wound, and interfere with its quick union; or else they are removed by too much surgical interference, too frequent introduction of a scoop, or a suction-curette, or a syringe, or by too much squeezing and pressing of the eyeball. Overmuch manipulation of the eye is, I think, the radical fault both of the modified flap extraction and of the scoop extraction, and, indeed, of most of the attempted improvements of the flap operation.

As for loss of vitreous humour, which, without the slightest fault of the surgeon, sometimes takes place as soon as the corneal flap-wound is completed, it is equally liable to occur during scoop extraction, if the scoop is allowed to pass too deeply backwards, behind the lens, so as to rupture the hyaloid membrane; and an escape is still more probable during the squeezing and pressure which are inseparable from Graefe's modified flap operation.

In giving a preference to the older flap operation, as being, *upon the whole*, preferable to the other forms of extraction, I am quite aware how much I am influenced by the fact of my having been accustomed to the constant performance of the former operation for a period of nearly twenty years before any modification of it was invented. When I tried the scoop operation in cases which appeared to be especially suitable for it, I found that, while the most successful cases left the patient with a deformed and enlarged pupil, and with the optical annoyance of circles of

dispersion, inseparable from that condition, I had in less favourable instances to contend with chronic opacity, insidiously invading the cornea, in patients whom I had selected for scoop operation in consequence of feeble reparative powers, which seemed to render dangerous the larger wound of a flap extraction.

CHAPTER XI.

GLAUCOMA.

(Plate II., fig. 3.)

'Glaucoma' is a term which in process of time has acquired a meaning quite different from that originally conveyed by it. Among the ancients 'glaucoma' signified opacity of the lens, and was therefore regarded by them as a wholly incurable disease, inasmuch as to remove the lens from its position would have been deemed equivalent to displacing the very seat of sight. At a later period the etymology of the word caused it to be applied to many cases of greatly impaired or lost vision attended with fixed dilatation of the pupil; for, in such cases, the change of colour which the lens naturally undergoes in old age, and some slight diminution of its transparency, combined to impart to the light reflected from the fundus of the eye a greyish or drab colour, which, in descriptions, was exaggerated into green; and much labour was expended by ophthalmic writers, not many years ago, in attempts to explain the cause of this so-called green or *glaucous* tint. In fact, the dull greyish reflex, upon which so much stress was formerly laid, may be perceived, whenever the pupils are dilated, in the eyes of almost any old person whose lenses are beginning to be cloudy.

The word 'glaucoma' has now come to be used—without any reference to its etymology, and in a purely arbitrary sense—to signify a disease gradually involving the most important tissues of the eyeball, and, if left to itself, ending in total blindness.

It is only since the late A. v. Graefe drew special attention to the subject, that the important *premonitory symptoms* of glaucoma have been estimated at their true value. Long before his time, the more advanced stage of glaucoma, and especially the strongly marked and unmistakable outward appearances of the disease in its complete form, were perfectly familiar to the profession; but the connection between this hopeless form of blindness and an earlier stage of inflammatory action was not understood; and the merit of explaining this connection, of showing how inevitably changes, apparently of no extreme urgency, lead the way to incurable loss of sight—above all, the invention of operative means for arresting these changes, and restoring the eye to usefulness—all this merit belongs to Graefe.

I will first notice the appearances of glaucoma in its complete stage.

The patients are mostly beyond the middle period of life.

They are usually pale and unhealthy in appearance, often showing that worn expression which becomes impressed on persons who have gone through much suffering.

The eyeball, instead of having the slight degree of elasticity natural to it in health, is remarkably hard, giving to the finger almost the sensation of a stone.

The sclerotic, often marked with faint dusky patches, is traversed by large, purple, tortuous veins, which emerge abruptly, close to the margin of the cornea. Sometimes there is also a slightly-marked vascular zone.

The cornea, although it may be sufficiently transparent to allow of the iris being well seen, presents a peculiar unevenness of its epithelial surface; so that the lines of a window-frame, instead of being distinctly depicted on the corneal surface, appear wavy and irregular: and the reflected light is dull, like that from a slightly steamy

glass. In some cases the cornea is hazy throughout its substance, and occasionally the epithelium is found vesicated in small patches.

If the state of the cornea allows a good view of the iris, these two structures will usually be found in close approximation to each other, the pupil being dilated to its fullest extent; sometimes the pupil is less dilated, but irregular. The change in the appearance of the iris is very characteristic. Its sharply-defined fibrous character is lost, and it assumes a peculiar *slate-colour*. Sometimes the veins of the iris are sufficiently enlarged to be distinctly visible to the naked eye.

The lens advances very near to the cornea, and in cases of old standing is opaque. Sometimes this opacity has a milky appearance, with slight indications of striæ, and the whole lens looks full and swollen, as if it had undergone maceration, and were about to burst its capsule. Occasionally the divisions between the planes of lens-fibres are very distinctly seen. The lens may vary much in colour, appearing greyish or greenish drab, dirty yellow, or dull orange.

Perception of objects is wholly lost; sometimes even all perception of light.

An eye may present all the above-mentioned appearances in consequence of slow disease, advancing, with intervals of quiescence, during months or even years; or, on the other hand, the same appearances may be the result of an acute inflammatory attack, coming on in the most sudden manner, and within a few days producing all the changes above noticed, with the exception of the opacity of the lens, which takes place more slowly.

Mere inspection of an eye in which glaucoma is complete will not enable the surgeon to decide whether the morbid changes have been the result of the *chronic* or the *acute* form of the disease.

I have already alluded to the merit of Graefe, in having been the first to connect that well-known incurable condition of the eye, to which alone the term glaucoma was formerly applied, with a definite train of premonitory symptoms, marking a period during which surgical treatment might be of service. These peculiar premonitory symptoms consist in intermittent attacks of dimness of sight. A patient perhaps sees well up to the middle of the day, then objects appear as if involved in smoke, and reading becomes difficult or impossible. This dimness may last for the rest of the day, and the next morning it may have quite passed off, to return again in the course of a few hours. This intermittent dimness may go on for months, with little, if any, external appearance of inflammation; in other cases, the onset of dimness is attended with slight redness and watering of the eyes. In fact, unless the peculiar premonitory symptoms of incipient glaucoma are well understood, a case of the most serious kind may be lightly regarded as one of unimportant catarrhal ophthalmia.

A luminous object, as a candle or a lamp, appears surrounded with a halo of prismatic colours. The iris approaches the cornea, and the pupil is inactive, although perhaps not dilated; and, unless the attack be very slight, the surface of the cornea, instead of presenting a brilliant mirror-like smoothness, will appear slightly dull, like a glass that has been breathed upon; so that the lines of the window-frames will be reflected in a faint and wavy form. This uneven and dull appearance of the corneal epithelium is a very valuable diagnostic mark in all stages of glaucomatous disease, and will often arouse the suspicions of a careful observer in cases which might otherwise be thought unimportant. It is invariably present in all advanced and confirmed cases of glaucoma. The premonitory obscurations may persist for weeks, with occasional interruptions, even for months; and patients may be liable to intermittent attacks for a year or more, before any outburst of acute inflammation occurs. Neuralgia in the ophthalmic division of the fifth nerve is commonly added to the other premonitory symptoms.

If the eyeball be carefully examined during any period of glaucomatous disease, it will be found in some degree harder than natural. This hardness goes on increasing, until, in the last stage of glaucoma, the globe feels almost like a ball of stone.

I know of no instance in which the *tactus eruditus* of the surgeon is more

severely tested than in examining some of these incipient cases of glaucoma. The same eyeball may suggest to two able examiners different degrees of hardness, or they may even disagree as to whether the eye be abnormally hard at all.

While the patient gently closes the lids, the surgeon is carefully to apply the tips of his fingers upon the upper part of the globe, lightly pressing upon its coats. And again, when the patient opens the lids and looks upwards, the surgeon presses the middle part of the lower tarsus steadily against the sclerotic, just below the cornea, and carefully notes the degree of resistance he meets with. I need hardly say that too great softness of the globe is as much a mark of disease as too great hardness, and that, to discriminate truly between the various degrees of what is too hard and what is too soft, the surgeon must familiarise himself with the exact amount of firmness and elasticity indicative of a sound state of the coats and humours of the globe, by means of that careful fingering with repeated practice alone can give.

Donders, Bowman, and others have devised formulæ for noting down the amount of tension existing in the globe, but the gradations are so manifold, that it is barely possible to tabulate them correctly according to any fixed plan.

Rest of the eyes, careful attention to general health, and iodide of potassium internally, I have found to constitute the best mode of treatment in this stage; but the patient must be warned as to the true significance of the symptoms, and as to the probable onset eventually of acute glaucoma.

It was to the ophthalmoscopic appearance of the optic nerve and its vessels, in all stages of glaucomatous disease, that Graefe drew such special attention. In well-marked cases the optic nerve appears concave, and the retinal vessels, instead of passing off from their point of emergence in a straight direction, to ramify on the retina, begin by curving over the edge of the cup-like depression at the end of the nerve.[1] Very slight pressure on the globe with the finger causes visible pulsation in the retinal vessels; or this pulsation may exist without external pressure.

In the slowly-advancing early stage of glaucomatous disease, the depression of the optic nerve may be so trifling as to escape observation; but in confirmed cases it is very marked. When the disease has come to a crisis, and acute glaucoma has set in, the details of the optic nerve and retina cannot be seen with the ophthalmoscope, owing, I believe, in great part to the condition of the corneal surface, which produces irregular refraction of the rays of light. In the advanced stage of glaucoma a dull red glow is sometimes all that can be seen.

As disease goes on, the dimness of sight, instead of being intermittent, becomes permanent, and the field of vision gradually contracts, so that at last the patient in viewing objects seems to be looking at them through a small hole in a screen. Sometimes, however, this narrowing of the field of vision does not take place, the dimness being pretty uniformly diffused. By this time other marked changes have taken place in the globe. It has acquired a peculiar stony hardness; the veins on the sclerotic emerge abruptly near the edge of the cornea as thick purple trunks: the pupil gradually dilates until in old cases the iris almost disappears, acquiring at the same time a peculiar slaty tint. Eventually the veins of the iris enlarge, and are especially noticeable as a ring-like plexus near the pupillary margin. The lens at last becomes opaque, milky-looking, and indistinctly striated; it is often of a greyish drab, dirty yellow, or dull orange, and marked with earthy streaks and patches. Its threefold division is often very well marked, as if by undergoing maceration in water, it had swollen up and were about to burst its capsule. By this time even perception of light is usually quite lost.

From what I have already stated as to the various changes in glaucoma, it will be understood that it is by a careful comparison and estimate of several morbid appearances taken together, that the disease is to be discriminated, and not by the presence of any one distinctive sign. If mere abnormal hardness of the globe be

[1] Plate II. fig. 3. This is a diagram, not a drawing from an individual case. It shows, in a rough way, the abrupt curve of the vessels, the concave form of the optic disc, and the grey tint which the latter sometimes assumes in the very advanced stage of true glaucoma, or of grey atrophy of the optic nerve.

assumed as the proof of glaucomatous change, several forms of inflammation and degeneration quite distinct from glaucoma may be mistaken for that disease. A 'cupped' condition of the optic nerve may simply be the result of chronic wasting. Coloured halos around luminous objects are commonly associated with ordinary catarrhal ophthalmia. But let all these symptoms co-exist;—intermittent obscuration of vision, prismatic halos, fixity of the pupil, increased hardness of the globe, a changed condition of corneal epithelium, cupping of the optic nerve—and the diagnosis becomes an absolute certainty.

I have said that the course of the glaucomatous process is usually more or less gradual, a longer or shorter premonitory stage preceding the onset of an acute attack; but this sometimes comes on suddenly, frequently in the night, the patient having gone to bed apparently well, and being aroused from sleep by intense neuralgic pain to find himself all but blind. When such an attack occurs, on account of the hazy condition of the corneal epithelium, or some change in the vitreous body, or from both causes combined, the optic nerve and retina cannot be discerned, and the ophthalmoscope only reveals a dull red glow from the fundus.

Treatment of glaucoma.—While cases of chronic glaucoma which had advanced to their last stage were abandoned as wholly incurable, and beyond all treatment; those of the acute form (under the name of *ophthalmitis interna*, *ophthalmitis arthritica*, &c.) were formerly treated on antiphlogistic principles, pushed to the severest extremes; profuse bleeding, both local and general, and mercury in salivating doses, being the common means employed to check the progress of disease. Some practitioners regarded gout as the primary cause, and, in addition to depletion, employed colchicum, or other anti-arthritics.

In spite of every form of treatment, glaucoma remained the *opprobrium* of ophthalmic medicine; and the announcement, therefore, of its curability by means of an operation at once attracted general attention. In 1857 Graefe [1] published an account of this operation of 'Iridectomy,' and he also brought the subject before the Ophthalmological Congress which met at Brussels in that year. An incision was to be made through the cornea, close to the sclerotic; a considerable portion of the iris was then to be grasped with a forceps, drawn out, and cut off. By this operation the 'intraocular pressure,' which was the cause of all the phenomena of glaucoma, would at once be removed.

His operation is performed as follows. The globe having been fixed with a forceps, a lance-knife is passed obliquely through the sclerotic, about a line and a half from the spot where it blends with the cornea, so as to make a wound penetrating into the anterior chamber. An iris-forceps is then passed through the wound, a fold of iris seized, drawn out, and then cut off close to its ciliary attachment. Graefe and others lay particular stress upon the iris being removed quite up to this point, but I do not believe it to be at all essential. I have always performed the operation with a Beer's knife, making, in fact, a corneal wound like the upper section for flap extraction, but on a much smaller scale. The wound is a good deal anterior to that recommended by Graefe, and passes through the true cornea, but close to its sclerotic union. The iris, consequently, is not divided quite up to its ciliary attachment; and yet I have found the result of the operation just as satisfactory as that first described. In acute glaucoma the lens always advances forwards, close up to the cornea, and is therefore endangered by the thrust made with the lance-knife; whereas, in using Beer's knife, in the way I have mentioned, its point is always kept in front of the iris as it lies against the projecting lens. The long knife devised by v. Graefe for peripheral linear extraction will be found even more convenient than a Beer's knife. It appears to me that, if a peripheral portion of iris

[1] See his essay in the *Archiv für Ophthalmologie* (vol. iii. p. 456), entitled *On Iridectomy in Glaucoma, and on the Glaucomatous Process.* Also (vol. iv. p. 127, 1858), *Farther Clinical Remarks on Glaucoma, Glaucomatous Diseases, and the Curative Effects of Iridectomy.* These two essays, together with another *On Coremorphosis as a Remedy in Iritis and Iridochorioiditis*, were translated, under slightly changed titles, by Mr. J. Windsor, and published by the New Sydenham Society (vol. v. 1859).

is removed, sufficient to establish a free communication between the anterior and posterior chambers of the aqueous humour, the object of the operation has been attained.[1]

Hancock recommended the following operation in glaucoma, as being greatly preferable to iridectomy. The point of a cataract-knife is inserted at the lower and outer part of the edge of the cornea, and carried in a direction obliquely downwards, dividing the sclerotic to about the extent of two lines, and penetrating through the corpus ciliare into the vitreous humour. The incision also divides the attachment of the iris, and the delicate fibres constituting the 'ciliary muscle.' The division of these fibres, which I have already spoken of as chiefly constituting the apparatus for changing the form of the lens in the act of accommodation, was regarded by Hancock as the essential point of the operation, since he believed their spasmodic contraction to be the primary cause of the phenomena of glaucoma.

In performing the operation of iridectomy, great care must be taken to avoid wounding the lens, which, as I have said, always projects towards the cornea, and is sometimes in actual contact with it. This danger is avoided by making the corneal incision in the way I have recommended.

A good deal of blood usually flows from the cut iris into the anterior chamber, sometimes quite filling it. This blood soon becomes absorbed, if the eye is kept at rest, and bandaged with a carefully adjusted amount of pressure, for twenty-four hours. When, after this period, the eye is examined, the cornea is found to be clear, and the peculiar unevenness of its epithelial surface has given place to the normal mirror-like smoothness.

The recovery of sight after a well-timed and well-performed iridectomy is most remarkable, in many cases almost amounting to the restoration of former good vision, where it has been done before much organic change has occurred in the optic nerve, and where the loss of vision mainly depended directly on the excessive pressure and in a minor degree on atrophic degeneration. It is for this reason that iridectomy gives better results in this form of glaucoma associated with inflammation (glaucoma cum ophthalmia) than in the more chronic form.

Recently sclerotomy has been advocated by some as a substitute for iridectomy, which even sometimes succeeds where iridectomy has failed permanently to relieve excessive pressure. With a long narrow Graefe's extraction knife an incision is made in the sclero-corneal junction tangental to the circumference of the cornea. After the periphery of the anterior-chamber has been transversed by the point of the knife, and a counter-puncture made, some leave a small bridge of sclero-corneal tissue undivided; others cut out through this, but leave the conjunctiva unsevered.' The tendency to prolapsus iridis may be diminished by the previous use of eserine. But this drug is not only of use as a preliminary to iridectomy; it is of the highest value in lowering excessive intra-ocular pressure. A solution of the sulphate of eserine (gr. ii. to ℥j aq. dest.) dropped at short intervals several times into the eye will not unfrequently produce a decided remission of tension in cases of acute glaucoma cum ophthalmia, and enable the surgeon to perform iridectomy or sclerotomy with much less risk of intra-ocular hæmorrhages. It is scarcely less useful in the chronic forms of the disease.

The precise rationale of iridectomy as a curative means still remains to be accounted for; and it must so remain until we become acquainted with the first origin of glaucoma. We speak, indeed, of the disease as consisting in 'intra-ocular pressure,' but why the fluid contents of the globe are in excess, so as to cause this pressure, is unexplained. We must be satisfied practically to employ iridectomy or sclerotomy, without being able to give any clear theoretical reason for our procedure.

[1] If this view be correct, the explanation which those who prefer Hancock's operation have offered, as accounting for the beneficial effect of iridectomy, becomes inconclusive. They consider that the unintentional division of the fibres of the ciliary muscle, during the performance of Graefe's operation, and not the removal of the piece of iris, constitutes its real value. But if iridectomy, performed in the way I have recommended, be found as effectual as when the iris is removed quite up to its ciliary attachment, it follows that division of the ciliary muscle can in no way contribute to the beneficial result of the operation.

CHAPTER XII.

DISEASES OF THE LACRYMAL APPARATUS.

The lacrymal apparatus comprises the lacrymal gland, which secretes the tears—the puncta and canaliculi, which convey them into the lacrymal sac, where they temporarily accumulate—and the lacrymo-nasal canal, whereby they are finally conveyed into the lower chamber of the nose.

If we consider the small calibre of the canaliculi, we can readily understand that a very slight degree of thickening in the delicate membrane which lines them, or a trifling displacement of the puncta, can suffice to disarrange the mechanism of taking up and carrying on the tears; and accordingly we find that watering of the eye (*epiphora*) is a frequent symptom in various forms of conjunctival inflammation. It also constitutes of itself a troublesome condition, which is constantly being brought under the surgeon's notice.

If the puncta are quite impervious, of course the tears must trickle down the cheek as fast as they are secreted. A contraction or stricture of the puncta or canaliculi will cause a less complete overflow. If the lacrymo-nasal canal be strictured, or its outlet obstructed, the tears passing into the sac will accumulate there, and, together with the pent-up mucus, form a swelling termed *mucocele*. Unless relief is obtained, the distended sac becomes inflamed, and pus is formed, which eventually discharges itself through an opening in the skin, constituting true *fistula lacrymalis*. This term, however, is often incorrectly applied to abscess of the sac without any perforation of the skin.

When a case comes before us in which there is a continual watery state of the eye, our attention should be at once directed to the puncta. These apertures, in a healthy state, are in contact with the ocular conjunctiva, so that, to bring them into view, it is necessary to draw the margin of the tarsus a little away from the eyeball. If the conjunctiva lining the lower lid has become considerably thickened from chronic inflammation, the edge of the tarsus may be so much everted as to cause the punctum to face upwards, or even directly forwards. In such a position it can no longer take up the tears, which accordingly run over the edge of the lid. In extreme cases of *lippitudo* and chronic ophthalmia, the puncta, still retaining their natural position, are sometimes found to be so completely obliterated that their position can no longer be detected.

If the puncta are in their natural position, and their openings appear unobstructed, and yet no tears can be made to regurgitate through them when the point of the finger is firmly pressed against the lacrymal sac, just below the tendon of the orbicularis palpebrarum, we may suspect some stricture to exist in the canaliculi. We can ascertain this only by exploring them with a fine probe. This may seem to be a very simple matter; but it requires considerable care and tact, without which much serious mischief may result. The membrane lining the canals is extremely delicate, and any want of gentleness in passing the probe may tear the membrane, and so give rise to fresh obstruction. We must bear in mind the abrupt turn which the canal makes at a short distance from the punctum. In passing a probe into the lower canaliculus, the instrument should be directed almost vertically downwards for about half a line, and then turned inwards towards the nose, in which direction it will pass on, should no stricture exist, until its point strikes against the inner wall of the sac, where it lies against the bone. During the whole process of introducing the probe, the tarsi should be kept on the stretch, by drawing outwards the external canthus.

Except to a practised hand, it is often difficult to detect whether the point of the probe is arrested close to the junction of the canaliculus with the external wall of the sac, or whether the point has reached the internal wall. In the former case any onward pressure with the instrument produces a slight dragging of the tarsus;

whereas contact of the probe with the inner wall of the sac not only conveys to the hand a peculiar feeling of firm resistance, but at once causes all movement of the tarsus to cease.

If the canaliculi be found free from stricture, and the sac forms a distinct prominence below the inner canthus, it is pretty certain there is an obstruction at the lacrymo-nasal canal. If this canal be perfectly closed, while the canaliculi are free, firm pressure of the finger on the swollen sac will cause its contents to escape at the puncta; but if the canal, although narrowed, be pervious, steady pressure in a direction downwards and a little backwards may overcome the resistance of the stricture; the swelling then suddenly yields, and the contents of the sac pass into the nose.

When we consider that the membrane lining the outlet of the lacrymo-nasal canal is that common to the chambers of the nose, we cannot be surprised that catarrhal inflammation of this membrane should be a frequent cause of lacrymal obstruction. If pressure on the sac suffices to empty its contents into the nostril, the inconvenience of the partial obstruction at the outlet may be kept in check by the patient taking care frequently to make this pressure, and to use at the same time other means for restoring the lining membrane of the sac as well as that of the nose to a more healthy condition. But if this pressure is omitted, and the tears and mucus are allowed to collect and to distend the sac, this distension, under some attack of catarrhal inflammation, may suddenly transform the chronic disease into an acute one. Pain is then felt in the part; the lids become red and puffy,—sometimes assuming an erysipelatous appearance; and the patient is quite unable to separate the tarsi. The swollen sac feels hard to the touch, and even slight pressure on it is extremely painful, while it fails to press out anything from the puncta.

These symptoms show that suppuration is taking place within the sac. If the case is left to itself, the pus escapes by bursting through the skin, and the opening frequently remains fistulous, allowing the tears, which have passed through the puncta into the sac, to trickle out upon the cheek, thus constituting a true *fistula lacrymalis*. After all inflammation has passed away, and the redness and swelling which attended the formation of the abscess have disappeared, the fistula often contracts to such a small aperture, that, were it not for the tears which slowly distil from it, the opening would hardly be perceptible. It is about the size of a pin-hole, and almost resembles one of the puncta in minuteness of aperture.

Treatment of lacrymal obstructions.—These obstructions, varying as they do from a slight thickening of some portion of the lining membrane of the sac or nasal canal, causing occasional watering of the eye, up to a total occlusion of the nasal canal, with displacement or stricture of the puncta and canaliculi, cannot of course all require the same kind of treatment. Astringent solutions of alum or tannin may be dropped into the corner of the eye, so that they may follow the course of the tears, and thus reach the thickened membrane. This object may be facilitated by slitting up the caniculus in the manner hereafter to be described. Each time the drops are used, the sac should be previously emptied, by pressing the point of the finger upon it in a downward direction. Should the lining membrane of the nose be in a thickened state, injections of astringent lotions into the nostril are of service; and in all cases attention to the general health and suitable tonic medicines are indicated.

Warm water-dressing should be applied whenever acute inflammation of the sac sets in with the symptoms I have described. This form of applying warmth and moisture is, in all affections of the lids and parts about the eye, to be preferred to poultices, as the latter frequently produce a troublesome form of eczematous eruption. Diligent application of water-dressing for four-and-twenty hours will frequently subdue acute inflammation of the sac to such an extent that not only do the redness and swelling of the lids disappear, but the thickening of the internal membrane gives way; so that gentle pressure over the sac suffices to empty its contents into the nose, and the case returns to its chronic condition. Should this not be the case, an incision must be made into the sac, and exit given to the pus.

There is hardly any form of local disease which has given rise to a greater variety of surgical treatment than chronic distension of the lacrymal sac, and stricture of its nasal duct. The distended sac has been compressed by an apparatus of pads, adjusted by means of springs and screws. The strictured sac or duct has been subjected to gradual dilatation by means of strings of catgut, introduced through an opening made into the sac, and brought out into the nostril; strings of increasing thickness being used as the canal would admit of their passage. Dilatation of the stricture was at one time attempted from below, by means of curved sounds, introduced into the sac from the nostril; but these instruments were difficult to introduce, there was great risk of breaking with them some of the fragile bones in the neighbourhood of the nasal duct, and they could not reach a stricture situated high up towards the entrance of the canaliculi. At one time metal tubes were placed in the cavity of the sac, which were intended to be healed in, and permanently to occupy its cavity; but Nature, disliking foreign bodies, even when introduced by a surgeon, always rebelled against them, and did her best to dislodge them, either upwards or downwards. The *style* maintained its ground longest, and formed the *ultima ratio* in every case of obstinate lacrymal obstruction. It was made long enough to reach from just below the tendon of the orbicularis palpebrarum, where an incision was made into the cavity of the sac to admit it, to near the floor of the nostril. The upper end was furnished with a nail-like head, to support the style in its proper position; and it was intended that the tears, entering by the puncta and canaliculi, should come into contact with the piece of metal, and glide down by the side of it into the nose. The style was to be taken out every day, cleansed and replaced; and at first the cure appeared perfect; but patients, from timidity, awkwardness, or carelessness, neglected this precaution, the instrument was seldom, in some cases never, removed, and eventually it became encrusted with earthy deposit from the tears, or was consumed by oxydation; the skin around the nail-shaped head was drawn in, and at the same time blackened with the sulphuret of silver,—in short, the style, so highly praised at first, became at last a source of annoyance and disappointment.

Bowman[1] suggested a very simple and useful operation, which, in many instances, suffices to cure *epiphora* resulting from contraction or displacement of the puncta, while at the same time it affords a ready access to any obstruction that may exist in the course of the sac or lacrymo-nasal canal.

Suppose that, in consequence of chronic ophthalmia, or from any other cause, the lower punctum has become displaced, so that, instead of facing towards the eyeball, it is directed upwards and forwards; the tears in such a case will run over the edge of the lid; and the object of the surgeon must be to transfer, as it were, the displaced punctum to a position where it can catch the tears before they overflow the border of the tarsus. The lid being put upon the stretch, a fine grooved director, or, in default of that, an ordinary punctum-probe, is to be passed along the whole course of the canaliculus, and held firmly there, while a fine sharp-pointed knife is run along the probe, as far as the caruncle, so as completely to lay open the canal, and thus extend its orifice backwards to the point where the tears accumulate. A very handy little knife, with a slightly bulbous point, has been invented, with which the canaliculus can be slit up without the use of any probe or director.

For several days after the incision has been made through the upper wall of the canaliculus a probe must be passed along its track, to prevent the lips of the wound growing together. In some persons it may be necessary to use the probe for ten days or more; in other cases there is hardly any disposition in the edges of the wound to unite.

When the overflow of tears depends simply on faulty position of the punctum, this laying open of the canaliculus may of itself effect a cure. In cases of obstruction in the lacrymal sac or its nasal duct, the incision affords an easy access to the seat of stricture.

Occasionally, however, another complication exists in a narrowing of the canali-

[1] *Medico-Chirurgical Transactions* for 1851, p. 338.

culus just at its point of communication with the sac, which may prevent the passage of a probe sufficiently large to act upon the stricture. In such a case a small straight cannula, containing a lancet-shaped point, which may be protruded or withdrawn by means of a spring,—in fact, Stafford's instrument for dividing urethral stricture, made on a miniature scale,—must be carried along the canaliculus, and employed upon the constricted spot.

The probes for dilating strictures in the sac or its canal must be of various degrees of thickness, but all sufficiently strong to sustain the requisite amount of pressure without bending. They are best introduced by the surgeon standing behind the patient; and it will be found advisable to avoid using those of too small a size, as they are of course more likely than those of a larger size to catch in a fold of membrane, or even to pierce the membrane covering the bony walls of the canal.

The tarsus being put on the stretch, the probe is passed along the newly-opened canaliculus until its extremity strikes against the inner wall of the sac. Still keeping its extremity in contact with this part, the probe is raised to a vertical position, and then carefully carried downwards to the seat of stricture. The canal inclines somewhat backwards, and this inclination is to be carefully borne in mind. The surgeon must feel his way with the point of the instrument, and be on his guard against using unnecessary force. In cases of old dilatation of the sac, its relaxed lining membrane readily catches in a fold against the point of the probe, and the surgeon must learn to discriminate between a check arising from this cause, and the obstacle encountered by the instrument becoming impacted in the constricted lacrymo-nasal canal. The length of the instrument which has been passed in, and the patient's own feelings, will prove whether the point of the probe has entered the nasal cavity.

It sometimes happens that, immediately after the first passage of the probe, the surgeon is able, by pressure over the sac, to force all its contents down into the nose; but if there has been much difficulty in passing the instrument, the membrane becomes swollen, and will allow the contents of the sac to pass only after the swelling has been relieved by fomentation.

No fixed rules can be laid down as to the frequency with which the probe is to be used, nor as to the length of time required for a cure. This will vary from a few weeks to several months, and relapses frequently occur long after the stricture appears to have been completely overcome. Too frequent use of the probe will set up irritation, and induce a more abundant muco-purulent secretion. When this takes place, the probe must be laid aside for a week or two, and fomentation, with water-dressing at night, be substituted.

During the whole course of treatment by means of the probes, the patient must never neglect several times a day to press out the contents of the sac, endeavouring to do this in a downward direction; or, if this cannot be effected, by pressure through the puncta.

Those who are about to treat a case of long-standing lacrymal obstruction by the passage of probes, should clearly understand how much care, tact, and patience such an undertaking requires. In consequence of the minuteness and delicacy of the parts concerned, the treatment of a stricture in the lacrymo-nasal duct demands even greater care and skill than that of a stricture in the urethra; and I am sure that those who have seen much practice will bear me out in asserting, that by far the greater part of obstinate and dangerous cases of the latter kind are due to meddlesome surgery rather than to any original disease.

The surgeon must bear in mind that the walls of the lacrymal sac and duct are composed of extremely brittle and fragile bones, and the rough introduction of a probe may either break some of these, or tear away the delicate and vascular membrane which covers them. Besides, as the lacrymo-nasal canal is a bony tube, all thickening of its lining membrane must take place concentrically; and therefore any undue violence, by setting up inflammation, is sure to increase instead of lessening the cause of stricture. On these grounds the practice lately advocated of forcibly

pushing through the obstacle probes of very large size, and of cutting it in several directions with a strong, narrow-bladed knife, should not be hastily adopted.

Even when all possible care and skill have been employed, the treatment of stricture in the lacrymal passages, by the means just described, is often extremely tedious; for the affection may be complicated with great dilatation of the sac, caries of the adjacent bones, or false passages of various kinds, resulting from previous mismanagement.

Dacryolithes.—This term has been applied to certain concretions which are sometimes met with in the lacrymal passages, in the canaliculi, in the sac, or in the ducts of the lacrymal gland, caused by the earthy salts contained in the tears becoming deposited in the form of a calculus. Watering of the eye, repeated attacks of inflammation in the sac, or swelling and suppuration about the canaliculus, and pain when the part is pressed upon, are the more obvious symptoms. A probe carefully passed into the canaliculus, or through it into the sac, would detect the presence of the concretion, which must be cut upon, and extracted with a scoop or other instrument.

Irritation of the lacrymal passages is sometimes caused by the intrusion of a detached eyelash into one of the canaliculi. In this curious accident the hair enters at the punctum, and passes on as far as the abrupt bend which the canal makes at about a line's distance from the orifice. Here it is arrested; its point protruding to a greater or less extent, and irritating the caruncle and semilunar fold. The symptoms induced are a pricking and itching about the inner canthus, with reddening of the neighbouring conjunctiva. If the hair be short, its point will protrude so little as to make it very difficult of detection; on its withdrawal, all irritation at once ceases.

DISEASES OF THE LACRYMAL GLAND AND ITS DUCTS.

The works of foreign writers present a formidable array of diseases affecting this gland, almost every form of acute and chronic inflammation, and enlargements, both simple and malignant, being recorded; while our own countrymen appear to have met with but few cases of the kind. My own experience would lead me to believe that, compared with the other glandular structures of the body, the lacrymal gland is very rarely the seat of disease. Its sheltered position beneath the projection of the frontal bone guards it, to a great extent, from external violence, and it appears but seldom to participate in the inflammation of neighbouring tissues.

One rare affection consists in an accumulation of tears in one or more of the obstructed excretory ducts, whereby a cyst-like tumour is formed in the upper lid (*dacryops*), becoming very visible when the lid is everted. If one of these enlargements is punctured, without attention being paid to the after-treatment of the case, the opening is apt to become fistulous (*dacryops fistulosus*), the lacrymal secretion continuing to distil through a minute aperture in the skin. Such a case may be treated on the same principle as a fistula of the parotid gland, namely, by passing in at the opening a thread, which, having been carried through the thickness of the lid, and brought out at its conjunctival surface, has a small knot made at one end. This knot is then drawn into the fistula, and, by continued traction of the other end, is made to ulcerate its way through the conjunctival surface. The tears being thus diverted, the fistulous orifice in the skin may be closed by paring and uniting its edges.[1]

Should the lacrymal gland really become the seat of malignant deposit, or should it be deemed advisable to extirpate it on account of chronic enlargement, or for any other cause, the operation would be a simple one, and would offer nothing worthy of remark.

In the only instances, three in number, where I have myself extirpated the

[1] See a well-reported case of *dacryops*, by Hulke, *Ophthalmic Hospital Reports*, vol. i. p. 287, 1859. In this instance a loop of thread was made to include a certain portion of the conjunctiva.

gland, it was not the seat of disease, but was removed to do away with the inconvenience of the overflow of tears, the puncta and canaliculi having been wholly destroyed by extensive burns. In one of these cases an artificial pupil I had made would have been rendered almost useless, in consequence of the flooding of the eye with tears, had their secretion been allowed to continue.[1]

CHAPTER XIII.

DISEASES OF THE EYELIDS.

So many various tissues enter into the formation of the eyelids that they must necessarily be liable to a great variety of diseases; but it would be absurd to attempt a description of all the morbid conditions which they share with the other portions of the common integument of the body.

The *orbicularis palpebrarum* is subject to a spasmodic twitching of some of its fibres, usually those of the lower lid, producing a visible quivering of the skin, popularly termed the 'live-blood.' To persons of an irritable nervous system this becomes teasing from its frequent recurrence. It is occasionally the result of intestinal irritation, especially that produced by ascarides, when a few doses of purgative medicine, followed up by tonics, usually suffice to put an end to the annoyance.

Epicanthus is a term applied to a slight deformity, sometimes observed in children, consisting in a crescentic fold of redundant skin at the inner corner of each eye, partly or wholly concealing the caruncle. It is associated with a depressed form of the nasal bones, and if, in after life, the bridge of the nose becomes more prominent, the fold of skin, to a certain extent, diminishes, although it never wholly disappears. *Epicanthus* imparts to the face an unpleasant, Chinese expression; and the only cure is by pinching up and removing a vertical fold of skin on the median plane, just between the eyebrows, and then bringing the wound accurately together.

Ptosis, or drooping of the upper lid, may exist in various degrees, producing merely a slight deformity, or becoming complete, so as wholly to obstruct vision. It will be spoken of under 'paralysis of the third nerve.' In some cases of congenital drooping of the lids, it is possible that the levator palpebræ muscle may be altogether wanting. Patients with this defect have no power of moving the lids except by calling into action the occipito-frontalis muscle. The lids do not present that transverse fold in the skin, which, in the normal state, corresponds to the upper part of the eyeball, but are smooth and unwrinkled from the eyebrow to the tarsus, while the forehead is furrowed by the frequent action of the occipito-frontalis.

The terms *Entropion* and *Ectropion* are respectively applied to the inversion and eversion of the margins of the lids.

The simplest form of *entropion* is that which is occasionally met with in children, the subjects of irritable ophthalmia, as a result of spasm of the orbicularis palpebrarum. Extreme intolerance of light induces this muscle to contract so often and so forcibly that at last the lower tarsus rolls over against the globe, causing an inversion of the eyelashes, which greatly adds to the patient's distress. Contractile collodion, painted on the skin of the lower lid, draws the part into a proper position, and keeps it so while suitable remedies are being employed to subdue the original disease.

A similar spasmodic inversion of the lower lid happens to old persons, in whom the skin is relaxed and the tarsus flaccid. The muscular contraction is repeated until at last the lid becomes so rolled upon itself, that both the cilia and the tarsus are completely hidden, and the border of the lid appears to be formed of common

[1] See *Guide to the Practical Study of Diseases of the Eye*, 2nd edition, 1859, p. 417.

integument. In these cases of extreme inversion the irritation is really much less than when the inversion exists to a slight degree. For in the latter case the points of the cilia are brought into direct contact with the ocular conjunctiva, while in the former case the tarsus rolls over so completely, that the points of the cilia become buried in the fold of palpebral conjunctiva, and consequently do not come into contact with the globe at all.

A far more severe and obstinate kind of entropion is that which follows chronic inflammation of the palpebral conjunctiva, especially neglected or maltreated purulent ophthalmia. The upper tarsal cartilage becomes so much curved upon itself, that the whole range of eyelashes turns backwards against the globe. This curving of the tarsus is often aggravated by the long-continued application of solid nitrate of silver and sulphate of copper to a granular conjunctiva. If in such cases we evert the lid, we find a pale smooth cicatrix occupying its deep concavity. Partial or complete inversion of the margin of the lids may also result from contraction of the conjunctiva, following injury from acids, caustic alkalies, or burns.

A great variety of operations has been devised for the cure of entropion. In that form, so common in old persons, where the inversion is owing to contraction of the orbicularis muscle acting upon a flaccid lid, a cure can usually be effected by removing an elliptical portion of the skin of the lid, together with the subjacent fasciculus of muscle, and then accurately uniting the wound with fine sutures. It requires care exactly to calculate what quantity of skin should be taken away; and of course the removal of too large a portion would cause eversion of the lid, and so produce a deformity of the opposite kind.

If the tarsal cartilage be so much curved that removal of skin is insufficient to draw the eyelashes away from the globe, recourse may be had to an expedient suggested by Streatfeild. The skin of the lid being carefully dissected up, sufficiently to expose the convex surface of the tarsal cartilage, a long narrow wedge-shaped slice is cut out from this, so as to form a groove extending the whole length of the tarsus. The curved cartilage thus becomes bent backwards, as it were, and the skin being restored to its position, is united along the cut edges with a few fine sutures.

Should all these plans fail, and the eyelashes still irritate the globe, the whole row must be dissected off, together with that portion of the tarsal margin in which their roots are imbedded.

Ectropion, or eversion of the lids, may exist in the most various degrees. Its worst form is seen as a result of burns of the face, followed by extensive contraction of the cicatrices.

A spasmodic form of ectropion is often seen in purulent ophthalmia of infants, and in scrofulous and irritable ophthalmia of older children. In infants the unsightly appearance of the bright red and swollen conjunctiva gives rise to great alarm in those who have the care of the child; but they may be assured that, as the inflammation subsides, the deformity will gradually cease.

The chronic forms of *ectropion* in adults, which are produced by granular thickening of the conjunctiva after purulent ophthalmia, or by the contraction of cicatrices in the skin surrounding the palpebral aperture, the result of ulcers, burns, exfoliation of bone, &c., require a variety of operations, according to the special nature of the case.

When, after chronic ophthalmia, the everted conjunctiva of the lower lid presents a thick mass of granular excrescences, without any material elongation of the tarsus, or disease of the neighbouring skin, a cure may sometimes be effected by removing with scissors the greater portion of the palpebral conjunctiva, and then uniting the edges of the wound with very fine sutures. These may be left to ulcerate out by themselves, the lid being kept in proper position by the aid of a pad of lint laid along the margin of the tarsus, and fixed by means of several layers of lint saturated with collodion. In this way the lids are kept in contact with each other, and the apparatus need not be disturbed for several days. When the wound in the palpebral conjunctiva is closed, the loose stitches may be removed, and the pad of lint replaced until the cure is complete.

In very old and severe cases of ectropion, the tarsus becomes so much stretched, that, in addition to the removal of conjunctiva, it is necessary to take away a wedge-shaped portion of the elongated lid itself. Still worse cases, such as those resulting from burns or disease of bone, may require the formation of a new eyelid by the transplantation of a portion of adjacent healthy skin.

Trichiasis consists in an irregular growth of the eyelashes, the general form of the tarsus itself not being changed. Tinea ciliaris very commonly causes trichiasis, by inducing cicatrisation about the roots of the cilia. Sometimes three or four fine eyelashes present their points towards the globe, or even a single hair will grow in this direction, all the other hairs maintaining their natural position.

Trichiasis, when existing only to a slight extent, causes constant annoyance to the patient, by a sense of pricking, and by the constantly irritable and watery state of the eye which it induces. If only a few hairs grow irregularly, the removal of the entire tarsal margin need not be resorted to. The offending hairs must be carefully plucked out from time to time; or if they form a little group, they may be removed by dissecting out the small portion of lid external to the tarsus itself, in which their roots are implanted, and then uniting the wound with a suture.

To draw out an eyelash by the root seems a very simple and trifling matter; and yet there are few surgical manipulations in which care and the skilful use of a well-made instrument are so necessary. The cilia-forceps one commonly meets with are liable to cut the hair instead of merely grasping it firmly; and the stiff broken stump of a hair causes far more distress to the patient than its natural fine point. The hair should never be sharply jerked out, but removed with a slow steady pull.

Inflammation of the Lids.

The eyelids are of course liable to the various forms of inflammation which attack similar tissues in other parts of the body. A few inflammatory affections of the lids seem to demand notice on account of their presenting peculiarities of appearance, or being distinguished by special names.

A *stye* (*hordeolum*) is in fact a minute boil. It begins at the very edge of the lid, as a small, red, tense swelling, and at first is merely troublesome by the itching and sense of stiffness it occasions. As the inflammation goes on, the redness and swelling may more or less involve the whole lid, so that the eye becomes completely closed. In a few days matter forms, and shows itself at the summit of the stye; the cuticle gives way, pus and a small slough of areolar tissue escape; and then the redness and swelling subside, and the lid soon assumes its former appearance.

Scrofulous and delicate children are the usual subjects of styes, and they are comparatively rare in adults. Attention to the state of the bowels, carefully regulated diet, and the use of tonics, comprise the general treatment. Locally, warm water dressings are greatly to be preferred to poultices, which are apt to irritate the skin. The stye should never be rubbed or squeezed; and no incision is necessary, except, perhaps, a slight puncture through the cuticle when the pus is pointing.

Abscess sometimes occurs in the Meibomian follicles. These organs pour out upon the edges of the lids a greasy secretion, which prevents the tears running over, and causes them to flow onwards to the puncta. Sometimes a follicle becomes obstructed at the orifice, and the retained secretion forms a minute solid granule looking, when extracted, like a little grain of sand. If it projects sufficiently to touch the globe, a slight irritation is produced until the granule is removed.

If, however, the solidified secretion cannot in this way escape through the orifice of the follicle, it causes irritation, and at last a small abscess in the follicle itself. The lower lid is commonly the seat of these abscesses. They commence with a small patch of vascularity in the palpebral conjunctiva, a short distance from the free border of the tarsus, and gradually a yellow dot of pus forms in the centre of the vascular patch. If the conjunctiva at this point be punctured with a lancet, and a small scoop be introduced, the cause of the suppuration, a little nodule of stearine, about the size of a poppy-seed, may usually be turned out, and then all irritation subsides.

Tinea ciliaris,—termed also *ophthalmia tarsi*, *psorophthalmia*, *tinea palpebrarum*, &c.,—is one of the most common and troublesome diseases of the lids. It is too often neglected during the early stage, when alone it is really curable, and the surgeon is probably consulted for the first time when many of the hair-bulbs have already been irreparably destroyed, and the remaining hairs are misplaced and inverted, constituting the state called *trichiasis*. This term is frequently employed as if synonymous with entropion, but it ought properly to be restricted to mean displacement of the *hairs* themselves, while entropion signifies a turning-in of the *lid*.

Tinea ciliaris is seldom seen in its early pustular form; for the little pustules at the roots of the eyelashes soon break, and the discharge exuded from them dries into crusts, which cling about the hairs, matting them together, and sometimes almost concealing them from view. Tinea ciliaris, if allowed to go on unchecked, gradually destroys the tissues which secrete the hairs; and when the disease has thus exhausted itself, and the last crusts have fallen off, the tarsi, instead of presenting sharply-bevelled edges, appear rounded off, the skin and conjunctiva being gradually blended together into one smooth, red, shining cicatrix, in which neither cilia nor Meibomian orifices can be traced. Very often the puncta also become obliterated, and the tears consequently run over the cheeks, causing irritability and blinking of the lids. This is the condition to which the term *lippitudo* should be restricted; *tinea ciliaris* being understood to mean that state in which active disease at the root of the eyelashes is still going on.

In the *treatment* of tinea ciliaris, the chief difficulty arises from the age of the patients. Daily attention is required, to prevent the accumulation of crusts, which should be carefully washed off night and morning. Patients often derive but little benefit from the remedies prescribed, in consequence of this regular cleansing being neglected. It is useless to apply ointments anywhere except upon the very surface of the minute sores at the roots of the hairs; and if the latter are kept closely cut with scissors, the application of ointments, and the prevention of crusts, are greatly facilitated. Of course, this cutting of the eyelashes requires to be done by the surgeon himself, and the ointment should be neatly applied with a pencil. When cases cannot be thoroughly looked after, it is perhaps better to prescribe lotions, as they can hardly fail to reach the seat of disease. Ung. hydr. nitratis, ung. hydr. nitrico-oxydi, and ung. zinci oxydi, sufficiently diluted with vaseline, are the best ointments. The acetate of lead may be used as a lotion, in the proportion of from two to four grains in the ounce of distilled water.

The worst forms of lippitudo may often be greatly relieved by slitting up the canaliculi in the manner described at page 112. By this means the overflow of tears is checked, and this of itself is an immense comfort to the patient; while, at the same time, the tendency to ectropion, which long-continued lippitudo often induces, is considerably diminished.

Phtheiriasis.—Among the irritable conditions of the eyelids, I may here notice that arising from the presence of lice. These creatures are 'crab-lice' (*phthirius*), a species quite distinct from that which infests the scalp (*pediculus*). They thrust their heads into the skin at the roots of the cilia, and by means of the sharp claws with which all their legs, except the first pair, are provided, hold on so firmly, that they cannot be dislodged without great difficulty.

Phtheiriasis of the eyelids is an extremely rare affection, at least in this country. On superficial examination, the cases are very similar to those of tinea ciliaris. The eyelashes present a powdery appearance, and their roots seem to be clogged with yellowish-gray and brown crusts; but by careful scrutiny of these supposed crusts, the movements of the lice may be detected; and the powdery appearance of the cilia is owing to their being clogged with the exuviæ of the creatures, and dried sanies from the wounds they have inflicted. The insects may speedily be destroyed by thoroughly smearing into the roots of the eyelashes the white precipitate ointment (ung. hydrarg. ammonio-chloridi).

Morbid Growths of the Lids.

The following are the more common swellings which appear in or upon the lids.

Cysts, of two distinct kinds. Those of the first kind, extremely common, are met with both in the upper and the lower lid (*Encysted tarsal tumour*, Tyrrell; *Chalazion*, Mackenzie); the others are found almost invariably at one spot, namely, just over the external angular process of the frontal bone, to the periosteum of which they are attached.

Warts are sometimes found on the lids, differing in no respect from those on other parts of the body.

Nævi materni, resembling those of other parts.

1. *Cysts* of the lids are met with at all ages. They may exist singly, or several may appear together, coming successively to their full growth. The skin over them is quite unchanged, so that, when small, they are hardly recognisable except by the touch. They feel like half a hemp-seed or half a pea fixed by the flat side to the tarsal cartilage, and presenting a convexity towards the skin, which may be freely moved over them. They rarely exceed the size of a pea, except when suppuration has taken place within them.

If the lid be everted, the position of the cyst is recognised by a thinning of the tarsal cartilage, forming a dusky spot, around which the conjunctiva is reddened. These cysts may remain of a moderate size during life, without causing any inconvenience; but sometimes they suddenly inflame and become enlarged, the skin over them reddens and at last gives way, a small quantity of pus escapes, and afterwards a thin sanies continues to ooze from the aperture. But more commonly the pus makes its way through the palpebral conjunctiva, and then a little red fungous mass gradually protrudes, which, by the continual pressure of the eyeball, becomes flattened out into a mushroom shape.

When these cysts are so small as to escape ordinary observation, they require no treatment; but, if they become so large as to be unsightly, and, still more, if they inflame and suppurate, they must be treated in the following way. The lid being everted, a crucial wound is made through the conjunctiva into the cavity of the cyst. If the inflammation has been acute, pus escapes, otherwise a little serum. A scooped probe passed into the cavity, and twirled about in various directions, brings out the contents, which have a jelly-like appearance. Blood then fills the cyst, and makes it as large as it was before the incision. The patient, however, may be assured that this swelling will gradually subside. To prevent premature closing of the wound, and refilling of the cyst, the probe should be used in the way just described every third day for about a fortnight. The walls of the cyst come together, and ultimately form a slight thickening in the lid, just perceptible by the finger applied to the skin.

Fibrous cysts, varying in size from that of a large pea to that of a hazel nut, and containing sebaceous matter and hairs, are almost invariably confined to one situation, namely, just over the external angular process of the frontal bone. They appear to be congenital; at least, I have seen them of considerable size in infants four or five months old. The skin over the cyst retains its natural appearance, and it is only on account of the unsightliness that the surgeon is consulted.

In dissecting out the cyst, which is the only mode of treatment, great care is requisite to avoid cutting into it: and especially while the cyst is being separated from the periosteum, to which it always adheres pretty closely. The cavity is lined by a smooth membrane, and is filled with white greasy material interspersed with loose hairs. In a cyst removed by one of my colleagues from an infant five months old, these hairs were still growing from the lining membrane. It seems that, in the course of years, these hairs may attain a considerable size, while the fatty material degenerates into oil. Such was the case in a very large cyst which I removed from a woman between thirty and forty. The skin had become so much thinned as to have assumed a dusky hue; and in endeavouring to dissect out the cyst I punctured it, and there escaped a quantity of perfectly clear yellow oil. There remained within

the cavity only some detached black hairs, loosely curled together, and as strong as those of the head.

2. *Molluscum* attacks children in the form of small, white, rounded bodies, scattered over the lids, the alæ nasi, and about the corners of the mouth. When very small, these bodies are slightly reddish; but when as large as a pea, they are white, and exhibit at the apex a minute opening through which a milky fluid exudes on pressure. The readiest way to get rid of these unsightly masses is to split them all through with a lancet, and then to nip out with the nails the contents of each. The mass, when pressed out, looks almost like a fragment of parotid gland.

3. *Warts* may be snipped off with scissors.

4. *Nævi* of the lids differ in no respect from those met with in other parts of the body; but they require more careful and discriminating treatment, on account of the importance of avoiding, as much as possible, any considerable loss of skin; a large cicatrix being not only in itself unsightly, but likely, by its contraction, to cause distortion of the lid. Subcutaneous ligature, therefore, or the introduction of probes coated with fused nitrate of silver, must be preferred to including any portions of skin within a ligature, or extensively destroying it with escharotics.

I have seen injections of alum cause sloughing of the lids and great subsequent deformity; and such a result might follow the injection of any similar fluid into the loose areolar tissue of the part, unless some contrivance can be used to restrain the fluid within proper limits.

In the following case an injection of tannin proved successful.

A young lady was brought to me with a nævus on the upper lid, the size of a small hazel-nut. I was informed it had already been twice operated on by the introduction of threads steeped in nitric acid, and much inflammation and sloughing had ensued, as was proved by a considerable cicatrix of the skin near the outer canthus. The apex of the swelling was on the free margin of the lid, on everting which, a small bunch of veins, about the size of a barley-corn, was seen projecting through the tarsal cartilage, only covered by conjunctiva. The nævus seemed to be formed almost wholly by veins, the larger trunks of which could be felt through the skin, as they emerged below the superciliary ridge.

Having enclosed the whole upper lid in a 'ring forceps,' I could completely isolate the nævus from its parent veins, and I then punctured it with a very small narrow knife (Haye's needle-knife), and cut up its tissue subcutaneously. Being emptied of its blood, the nævus collapsed; and I next, with a fine syringe, threw in a few drops of a saturated solution of tannic acid. After a short pause, I relaxed the pressure of the ring forceps, and so allowed the returning blood to mingle with the injected fluid.

The subsequent inflammation produced a great deal of swelling and hardness of the lid; but the only slough was a mass about the size of a small pea, which made its way out at the little wound. The final result was complete obliteration of the nævus.

Galvano-puncture is a very useful method of treatment.

Carcinoma rarely commences in the lids, although it may spread to them from other parts. Should it be already far advanced when first brought under the surgeon's notice, extirpation would hardly be attempted. Small, hard, suspicious growths at the margin of the tarsus may be removed by excising a wedge-shaped portion of the lid on which they grow, and then uniting the wound with sutures.

The *epithelial* form chiefly attacks the skin over the lacrymal sac, and from that point extends over the nasal and superior maxillary bones, having the appearance of a shallow pale ulcer, with an irregular outline and uneven borders, and with a scarcely perceptible quantity of secretion. Chloride of zinc, made into a paste, and applied over the entire surface of the sore, so as to include its edges, will sometimes very effectually destroy the morbid growth, and it may be reapplied whenever any part of the border of the sore begins to exhibit fresh activity. Preferably the morbid tissue may be excised or removed with a sharp scoop before the application of the escharotic.

INJURIES OF THE LIDS.

Ecchymosis.—An effusion of blood into the areolar tissue of the lids, popularly termed 'a black eye,' is commonly the result of a blow; but it may arise from other causes, as, for instance, from the unskilful employment of leeches. The sufferer is always most anxious to get rid of the ecchymosis as quickly as possible; and I know of no treatment so efficacious as that handed down by the traditions of pugilism, consisting in the application of a poultice formed of the freshly-scraped root of the 'black bryony' (*tamus communis*), mixed with a due proportion of linseed-meal or bread-crumbs. Poultices of this kind produce a stinging sensation in the skin, and, if regularly applied for a day or two, seldom fail in effecting a complete absorption of the effused blood. Where this is not at hand, a compress dipped in Goulard water may be put on.

Emphysema.—This, like ecchymosis, is usually the result of a blow with the fist, which fractures some of the thin brittle bones, such as the lacrymal or ethmoid, forming the inner wall of the orbit. If, shortly after such an injury, the patient blows his nose, the eyelids suddenly puff up, so that he is unable to separate them. On pressing the part with the fingers, we at once perceive the peculiar crackling caused by the presence of air in areolar tissue. If the patient abstain from blowing his nose, the effused air soon becomes dispersed, and the swelling disappears.

Wounds of the lids have already been considered.[1] They are to be treated on the common principles of surgery which apply to other regions. The careful surgeon would naturally be alive to the importance of obtaining the nicest adaptation of cut surfaces in parts so open to observation. The yielding nature of the skin of the lids, and its plentiful supply of blood, offer peculiar facilities for effecting close and smooth union of wounds by means of fine sutures, in applying which the greatest care must be taken to avoid any irregularity and puckering of the cut edges.

CHAPTER XIV.

DISEASE OF STRUCTURES WITHIN THE ORBIT.

STRUCTURES very dissimilar, as regards their nature and functions, are grouped together in the present chapter; but they are all more or less concerned in supporting or imparting motion to the eyeball. The various morbid growths within the orbit, which cause displacement or impair the mobility of the organ, are also here briefly noticed.

PROTRUSION OF THE EYEBALL.

(*Proptosis oculi; Ophthalmo-ptosis; Exophthalmos.*)

Various causes may induce an unnatural prominence of the eyeball; but cases are sometimes met with in which this prominence seems of itself to form the whole morbid condition. The eyes have a remarkably staring expression, and look as if they were much too large for their sockets. The tarsi can be brought into contact; the eyes themselves move freely in all directions, and sight is unaffected. The equal amount of prominence in both eyes, and their unimpaired functions, at once remove any suspicion of orbital tumour.

Women of feeble and hysterical constitution, and those affected with bronchocele, are the usual subjects of this deformity, the cause of which is very obscure. Atony of the recti muscles has been suggested; and no doubt a weakened state of these muscles might produce a certain amount of prominence of the eye, but would be incompatible with its free motion. I have never seen any cure or benefit result from

[1] See INJURIES OF THE FACE.

treatment in these cases of proptosis. The reader is referred to the works of Graves and Basedow for good descriptions of this affection. The want of arterial tone which usually accompanies this form of proptosis suggests the use of iron and strychnine, and these sometimes appear to influence it beneficially.

Dislocation of the eyeball from the socket is an accident we often hear of, but, I need hardly say, that without rupture of the optic nerve the eye cannot be thrust upon the cheek, where it so often figures in the exaggerated accounts of patients. What really takes place is, probably, the lodgment of the upper lid behind the greatest convexity of the globe. I have seen this accident occur when a surgeon, anxious to explore the upper surface of the sclerotic, in search of a foreign body, or for some other cause, has too forcibly thrust back the upper lid. The tarsus, being forced beyond the summit of the eyeball, has suddenly slipped backwards, and become fast locked behind it. A wire elevator or a bent probe will enable the surgeon to lift up the tarsus and restore it to its place.

Hydatids, cancerous growths, and exostoses, by encroaching upon the cavity of the orbit, all give rise to gradual displacement of the eyeball. As this displacement increases, the movements of the eyeball become more and more limited, until at last it remains quite fixed.

It requires much careful investigation into the history of the case to enable the surgeon to determine the nature of the morbid growth. Exostoses are the slowest, and encephaloid tumours the most rapid in their progress. It is sometimes possible to pass in the tip of the little finger between the globe and the anterior edge of the orbit, and thus partially to explore the surface of the tumour. Cysts are recognised by a feeling of elasticity and fluctuation; and in doubtful cases a puncture with a fine trocar will sometimes reveal the true nature of the mass.

The removal of morbid growths from the orbit requires the utmost care, to avoid inflicting injury upon the eye itself or the optic nerve; and, before attempting such an operation, the surgeon should be well convinced that the mass is limited to the orbit, and has not extended into it from the cavity of the skull.

Abscess in the orbit occurs as a result of injury, such as the entrance of a foreign body; or it sometimes seems to be the effect of a chill. In a less acute form we meet with it as a sequela of fever and erysipelas. The suppuration is ushered in with rigors and depression; the conjunctiva and areolar tissue of the globe are red and infiltrated, the lids swollen and livid; the eyeball becomes prominent and immovable; and at length fluctuation can be detected by the finger passed in between the lids and the globe. The rapidity with which these symptoms follow each other would serve to distinguish suppuration from the growth of a tumour. Until fluctuation occurs, the existence of pus in the areolar tissue of the orbit is very obscure; the deep exploratory punctures which some surgical writers advise to be made between the eyelids and the globe are not free from risk, considering how closely the eyeball is surrounded with muscles and nerves, which random incisions would endanger; but a careful surgeon may sometimes succeed in safely opening a deep orbital abscess, and timely evacuation of the abscess is of the utmost importance to the safety of the eyeball.

Chronic abscess in the orbit is commonly the result of caries or necrosis; and the denuded bone will be felt by introducing a probe through the opening by which the pus has been evacuated.

Orbital abscess, even of the acute and so-called phlegmonous kind, so commonly occurs in depressed and feeble subjects, that light and nutritious diet, with a due proportion of stimulants, will be indicated instead of abstinence and leeches. The bowels should be rapidly unloaded, and then narcotics given in doses just sufficient to soothe pain and induce sleep. Bark and ammonia, wine and other tonics, will often be needed in increased quantities during the free suppuration, which not uncommonly follows the opening of the abscess. Warm water-dressing will be throughout the best local application.

Affections of Orbital Nerves.

The eyeball and its appendages derive their sensibility from branches of the ophthalmic division of the *fifth* nerve, which not only endows these parts with feeling, but also so far influences their blood-supply that total anæsthesia of the nerve is followed, sooner or later, by deranged nutrition of the cornea, and by other phenomena generally described as 'inflammatory.' The value of this as evidence of a trophic influence of the fifth nerve over the eyeball is lessened by the experiments of Snellen described in the *Archiv. für Ophthal.*

These phenomena have been already noticed in the Chapter treating of Diseases of the Cornea; and at present we may confine our attention to those motory nerves which supply the muscles of the lids and globe,—namely, the third, fourth, sixth, and 'portio dura' of the seventh, or facial.

The orbicularis palpebrarum is supplied by the last-named nerve, and when this is paralysed, the tarsi can no longer be brought into contact. If the patient is told to shut the eye, the lids remain immovable, if the paralysis is complete; or if it be only partial, a slight attempt at closure takes place. At the same time the eyeball is rolled upwards by the action of the superior rectus, as if seeking in that way the shelter of the upper lid. Sometimes the branch supplying the orbicularis palpebrarum is alone paralysed, but more frequently this is affected in common with the other facial muscles.

The orbital nerves, it will be remembered, are distributed as follows: the third to the levator palpebræ, the superior, inferior, and internal recti, and inferior oblique muscles; and also to the iris, through the medium of the ophthalmic ganglion. The fourth nerve supplies the superior oblique, and the sixth the external rectus.

It is not necessary that all the muscles supplied by one of these nerves should be affected at the same time, or to the same extent; but for the sake of illustration we will assume cases in which the various nerves have wholly lost their motory function.

The following are the symptoms of paralysis of the *third* nerve. The upper lid hangs motionless, and is in contact with the lower one (*ptosis*). On lifting it we find the globe abducted, so that the cornea is turned towards the temple. The patient can direct the eye still further outwards, but neither inwards, upwards, nor downwards. The pupil is dilated and fixed, and on that account distinct vision, for near objects, is impaired, although the optic nerve and retina may be wholly unaffected. By looking through a small aperture vision which diminishes the dispersion consequent on abeyance of accommodation, becomes improved. If the patient looks with both eyes at objects placed on that side of him towards which the affected eye is abducted, they appear single; while objects in the other direction appear double. If all the branches of the third nerve are paralysed, the inferior oblique muscle of course ceases to act, and the superior oblique having no antagonist rotates the globe on its antero-posterior axis, and hence vertical objects seen with the affected eye appear oblique.

If the *sixth* nerve alone be paralysed, the eye is turned inwards. This inversion can be increased at will, and the eye can be freely moved upwards and downwards; the pupil is of natural size and active, and the upper lid retains its motions unimpaired. If the patient looks at objects on that side towards which the eye is inverted, they appear single; but objects in the other direction are double.

Paralysis of the *fourth* nerve is much less common than either of the two forms already mentioned, and, on account of the very slight change it causes in the position of the eye, is very difficult of detection. The paralysis is chiefly to be recognised by its subjective phenomena. If, for instance, the patient with both eyes open fixes his attention on some straight line on the ground, as the edge of a gravel-walk, or the curb-stone of a foot-pavement, he sees two lines, one in its real position, and the other forming with it a more or less acute angle. If with both eyes he looks at a near object, such as a large capital letter, at such an angle that it appears double, the image perceived by the affected eye will incline from the perpendicular, and its

lines cannot be brought parallel to those seen by the sound eye, unless the patient inclines his head to one side. The letter T or a +, as containing right angles, are good forms for testing the defect.

The *treatment* of paralytic affections of the orbital nerves must be based on a careful investigation into the symptoms of each individual case, for the causes of paralysis may be very various. Slow, and eventually total, paralysis of one or all the nerves which enter the orbit may depend upon chronic changes in the brain itself, or the dura mater, the growth of tumours, disease of bone, &c. Sudden paralysis may follow apoplectic effusion or other injury to the cerebral structure, or may depend upon rheumatic inflammation of the fibrous tissues immediately surrounding and investing the nervous trunks.

Of course the prognosis would vary greatly accordingly as one or another of these causes had induced the paralysis. In the case of chronic brain disease, or the growth of intracranial tumours, the treatment could be only palliative. The probability of recovery in cases of apoplexy would depend upon the extent of the extravasation.

If one or more of the orbital nerves were suddenly paralysed, and at the same time other parts of the body were affected with loss of motory power, while the brain itself gave evidences of its whole circulation being disturbed, there would be comparatively little chance of the orbital muscles recovering their function. But if the paralysis were so completely limited to one of the orbital nerves as to render it probable that only some minute vessel in the course of the motor-tract had given way, and had involved the adjacent brain-fibres, the absence of all other cerebral symptoms would warrant the hope that considerable improvement, or even complete recovery, might take place.

By far the most hopeful cases are those where the paralysis of the orbital nerve can be traced to rheumatism; since a well-directed treatment of the general rheumatic diathesis will, in all probability, restore the affected nerve to a healthy condition. A large number of orbital palsies are due to syphilis.

Strabismus.

The various forms of mal-position of the eyeball just noticed, depending upon more or less sudden paralysis of the ocular muscles, might, according to strict etymology, be classed under *strabismus*; but the term is here restricted to those chronic cases in which habitual mal-position results from irregular action of either the internal or external rectus. The deformity may be defined as a faulty position of the eyes, whereby a separate image falls upon each macula lutea, when the patient endeavours to direct both eyes to one object at the same time.

Strabismus may be either *convergent* or *divergent*. In the former case the eye, or eyes, will be directed towards the nose: in the latter case towards the temple. The strabismus is termed 'single' if one eye only is misplaced, and 'double' when both eyes converge or diverge. In many cases which ordinarily appear as double strabismus, one eye becomes perfectly straight whenever the patient fixes his attention on an object; and the eye which thus for a time acquires a normal position will be found to have the stronger powers of vision.

In other instances of double strabismus both eyes maintain their inverted position, even while the patient is intently observing an object; but if the surgeon suddenly closes one of these convergent eyes, the other at once becomes straight, resuming its inversion as soon as the other eye is opened.

Donders has shown that in the great majority of instances convergent strabismus is associated with hypermetropia; and the divergent form with myopia. Divergent strabismus however is rare, except as a consequence of considerable loss of sight in one eye, persisting for several years.

The *causes* of strabismus are very various. When existing only to a slight degree, coming on only occasionally, and alternating from one eye to the other, it will sometimes be found due to intestinal irritation, such as that arising from worms. In other cases, it may be traced to the temporary cerebral disturbance induced by

teething, or to the more persistent form which attends hydrocephalus. An opacity near the centre of the cornea will sometimes cause an eye gradually to turn inwards, through a sort of instinctive effort of the organ to bring a clear portion of the cornea into use.

The *treatment* of strabismus, as will be evident from what I have just said as to its causes, must vary according to circumstances. The removal of intestinal irritation; the use of tonics; the employment of convex glasses, to correct extreme hypermetropia;—these, and many other means, may be useful to control strabismus which is only temporary, or which arises from peculiarity in the visual focus of the eyes. In every case a careful ophthalmoscopic examination is the first duty of the surgeon; and he should also take every possible care to ascertain that no organic disease exists in the brain or orbital nerves, and that there is no tumour in the orbit mechanically hindering the movements of the eye.

It is of no less importance to distinguish the strabismus due to palsy of the rectus externus from that due to hypermetropia. In paralytic squint the secondary squint is greater than the primary, and the mobility of the squinting eye is restricted. In hypermetropic squint the primary and secondary squints are equal in amount, and the mobility of the eye is not lessened.

The *operation* for the cure of strabismus consists in the division of the muscle, which, in consequence of shortening, or too great preponderance in contractile power, is permanently drawing the eye either inwards or outwards. Division of the internal rectus, when first introduced, was performed in the following way. The lids being held apart by an assistant, a small sharp hook was stuck into the sclerotic, close to the inner margin of the cornea, so as to fix the eyeball and draw it outwards. Then the surgeon, raising with a forceps a fold of conjunctiva midway between the cornea and plica semilunaris, divided it vertically with scissors, snipped through the sub-conjunctival tissue covering the tendon of the muscle, passed under it a blunt hook or director, and upon this divided with scissors, or with some kind of knife, either the tendon itself or the adjacent muscular portion of the rectus internus.

As in all other instances of manual surgery, the apparatus for performing this operation gradually became simplified. The spring speculum superseded the elevators held by an assistant; the sharp hook for fixing the globe was laid aside; and it was found that all the cutting could be done by scissors alone. The curious little knives, in every variety of form, which had been invented for dividing the muscle, are now for the most part forgotten; as are also the unseemly disputes about priority in trifling discoveries, and the exaggerated accounts of the uniform success which was stated to have attended the practice of certain strabismus operators.

The defects of this earliest form of operation were a too great separation of the ocular conjunctiva, inducing a subsequent retraction of the semilunar fold, and an over-weakening, amounting sometimes to utter loss of action, in the divided muscle.

We still occasionally meet with a fixed and leering eye which recalls the period of the first introduction of the operation in 1840; when every tyro fancied himself competent to cure a squint.

The deformity arising from retraction of the semilunar fold is now in a great measure obviated by sub-conjunctival division of the muscle. The lids are kept asunder with a spring speculum; and an assistant draws aside the globe, by nipping up with the forceps a little fold of conjunctiva and fascia near the margin of the cornea, at the opposite side to that on which the muscle is to be divided. Supposing the internal rectus to be chosen for operation, the surgeon, with scissors, divides the ocular conjunctiva horizontally, on a level with the lower edge of the cornea, and extends the incision towards the semilunar fold. Then he snips through the sub-conjunctival tissue, and having clearly exposed the sclerotic, slides upwards, between it and the rectus, a curved director. This serves to raise the muscle and make its fibres tense, and then with scissors the muscle is carefully cut through, close to its insertion into the sclerotic. This section of the muscle cannot be completed at a single stroke, but requires repeated use of the scissors, so that no fibres may be left undivided.

While this sub-conjunctival operation through a horizontal external wound obviates the retraction of the semilunar fold, it involves the risk of an imperfect division of the muscle, which is not exposed to the view of the surgeon. A careful exploration with the blunt hook or director must be made to detect any undivided fibres, before the spring speculum is finally withdrawn.

Graefe divided the conjunctiva a little below the equator of the globe and a few lines from the cornea, almost over the insertion of the tendon; exposed the sclerotic just enough to pass a curved blunt hook beneath the tendon, which is then snipped through close to its sclerotic attachment; care being taken that the hook, which is sharply curved, is not allowed to perforate the tendon, but is passed well under it. In this operation the tendon is not brought into view.

In dividing the *external* rectus, it must be borne in mind that the muscle is broader than the internal rectus, and is also inserted farther from the corneal margin.

Most cases of strabismus require the division of each internal rectus, even when the inversion of the better eye is but slight in comparison with the other. Instances, however, occur in which the inversion is wholly confined to one eye; and in such a case the faulty eye may alone be operated upon.

No absolute rule can be laid down as to the use of chloroform in strabismus operations. In most cases it will be found necessary: but where patients are fitted by age, intelligence and self-command to undergo the operation without it, the doubt which sometimes exists as to whether the muscle has been effectually divided can be at once solved, by directing the patient to attempt inversion of the eye; a test we are unable to employ when insensibility has been induced.

When, in searching for the muscle, the sub-conjunctival areolar tissue has been largely separated, it becomes infiltrated with blood, and forms a little prominence in the wound. The blinking of the lids gradually moulds this into a small button-shaped excrescence, attached by a narrow pedicle, which may be snipped through some weeks after the operation.

Removal of the Eyeball.

Certain diseased conditions of the globe may require a portion of it to be removed, while in other cases its tissues may be so extensively involved, and so much constitutional disturbance may in consequence arise, as to render necessary the total extirpation of the whole organ.

In non-malignant cases this operation is usually undertaken with a prospect of the patient afterwards wearing an artificial eye; and it therefore becomes important to consider whether a total or a partial extirpation will be best adapted to the end in view.

The enlargements which call for removal, on account of the deformity they occasion, are chiefly staphylomatous projections of the cornea or the sclerotic. Under the former term are commonly included projections which have really little or no corneal tissues within them, being formed of the iris coated over with fibrous tissue, after the true cornea has been partially or wholly destroyed by ulceration or sloughing. The sclerotic staphylomata, as they are called, are produced by gradual thinning and distension of the weakened fibres of the part from accumulation of aqueous humour or of serum. In some of the latter cases the eyeball acquires a very large size, and is extremely unsightly, on account of the dark leaden-coloured projections of the sclerotic, and the large tortuous veins which ramify over it. When the cornea has been extensively destroyed by sloughing or ulceration, it very commonly happens that the lens escapes through the breach; when this does not take place, the lens frequently becomes filled with a deposit of phosphate of lime, and this earthy mass, by pressing against the ciliary processes and iris, often causes severe neuralgia. In excising a staphyloma, therefore, the opening should be made sufficiently large to allow the lens, if still existing, to escape.

In operating, the lids must be held apart with a spring speculum or the fingers of an assistant. The surgeon then passes a cataract-knife through the staphyloma, and forms a flap, which he seizes with a forceps, and removes with a second stroke of the knife; if the lens presents at the opening, it is to be quickly tilted out with a scoop, and then the lids are instantly to be closed, and a cold sponge applied firmly over them. This immediate pressure is the most likely means for preventing hæmorrhage from the enlarged choroidal vessels, which sometimes give way the moment the fluid contents of the globe have escaped. Moderate pressure should be kept up until the risk of bleeding has gone by, and then water-dressing will be the only application required till the parts are healed. The portion of the globe left after the excision of a staphyloma gradually shrinks to a nodule, and as soon as this has ceased to be tender, an artificial eye may be applied.

If, in consequence of the sudden removal of the pressure which the accumulated fluids of the globe had been exerting on the choroidal and retinal vessels, the latter give way, and blood fills and distends the cavity of the sclerotic, extreme pain is the result, and it may even be thought desirable at once to extirpate all that remains of the globe, with the view of preventing future suffering. With the object of obtaining a better stump on which to wear an artificial eye, Critchett modified the operation for staphyloma as follows. He passed severed curved needles armed with threads through the sclerotic, above the base of the staphyloma, quite into the vitreous chamber, and brought out their points at the opposite side of the projection. He then cut away an elliptical portion from the front of the mass, drew the ligatures quite through, and tied them in knots, which then lay just across the line of the closed incision.[1]

Total extirpation of the eyeball.—This operation, except when malignant disease exists, should never be resorted to, so long as any sight remains in the organ; unless it should be so irritable as to lead the surgeon to fear that, by sparing it, the sight of the fellow-eye may be endangered. Restricted within due limits, and not undertaken through a morbid love of operating, extirpation of the eyeball is a ready means of relieving patients whose whole system may have become impaired by long-continued neuralgia, arising from distension of the globe, or lodgment of foreign bodies within its cavity.

The operation, which was formerly effected by scooping out all the contents of the orbit, has been greatly simplified by the adoption of Bonnet's method, in which the globe alone is removed. A circular incision is made through the conjunctiva and ocular fascia, and then each muscle of the eyeball is successively divided close to its insertion, and the optic nerve just before it pierces the sclerotic.

The operation is usually performed by raising with a hook all the tendons of the ocular muscles, and dividing them before cutting through the optic nerve.

I prefer the following plan, as simpler and more rapid. Having inserted the spring speculum between the lids, and made with curved scissors the usual circular incision of the conjunctiva, I grasp the external rectus and its surrounding tissue with a forceps, and snip them through; an assistant at once seizes the cut tendon close to its insertion, and draws the eye inwards. By sliding one blade of the scissors under the superior oblique and rectus muscle, they can be divided, and then the inferior rectus. The optic nerve is next snipped through, and the globe starts forward. A few strokes of the scissors divide the inferior oblique, internal rectus, vessels, and bands of areolar tissue, and the operation is completed. Cold water and exposure to the air suffice to arrest the bleeding, and then water-dressing is all that is required.

Use of Chloroform in Ophthalmic Surgery.

We may regard chloroform under two aspects: as saving the patient from pain, and as facilitating the manipulations of the surgeon. Now it is well known that

[1] *Ophthalmic Hospital Reports*, vol. iv. p. 1.

operations performed on the globe itself cause little pain, and last but a very short time. Those on the lids, involving as they do the wounding of skin, are of course more painful; but none of them are in this respect comparable to the larger operations of general surgery; and there are few adults who, if properly informed as to the real nature of such operations as those for cataract, artificial pupil, and strabismus, will not readily undergo them without the aid of anæsthetics. There are, however, many timid and anxious persons who are quite unable to go through the operations for artificial pupil and strabismus except under chloroform, and very few without its aid can encounter extirpation of the eyeball. It is also occasionally necessary to induce insensibility in order to examine eyes rendered irritable by disease, or by the presence of foreign bodies. In children all ophthalmic operations are greatly facilitated by the use of chloroform, and some can hardly be performed without it.

If a perfectly passive condition of the eye is so desirable during the delicate operation of flap-extraction, one would naturally expect to find chloroform peculiarly indicated in such a case. But it forms, I think, a special exception, for the following reasons. We have already seen (p. 94) that, when this operation of extraction has been properly performed, a successful result chiefly depends upon the rapidity with which union of the corneal wound can be effected. Now, with every precaution in the administration of chloroform, it will occasionally induce sickness; and the effort of vomiting may cause the vitreous body to escape through the opening just made in the cornea, thus inducing prolapsus iridis, with all its consequent irritation and hindrance to union of the wound. But, even without assuming so extreme a case, we shall find a very serious objection to chloroform in the nausea and disrelish for food which often follow its inhalation, whereby the nutrition and reparative power of the cornea become impaired during the critical twenty-four hours immediately succeeding the operation. [An anæsthetic is now usually given for extraction.—J. W. H.]

DESCRIPTION OF PLATES.

Plate I.

Fig. 1.—Diagram of the healthy fundus of the eye in a person of fair complexion, as seen by the indirect method of ophthalmoscopic examination.

Fig. 2.—Diagram of the fundus of the healthy eye in a person of swarthy complexion, as seen by the indirect method of ophthalmoscopic examination.

Fig. 3.—Diagram of the appearance of the fundus of the eye in disseminated choroiditis. The patient, æt. 38, had several years before had syphilis.

Plate II.

Fig. 1.—The ophthalmoscopic appearances exhibited in white atrophy of the papilla optica.

Fig. 2.—The ophthalmoscopic appearances in retinitis pigmentosa.

Fig. 3.—Diagram of the ophthalmoscopic appearance of the excavated papilla optica in an advanced stage of glaucoma.

J. Dixon, 1870.
J. W. Hulke, 1882.

PLATE I.

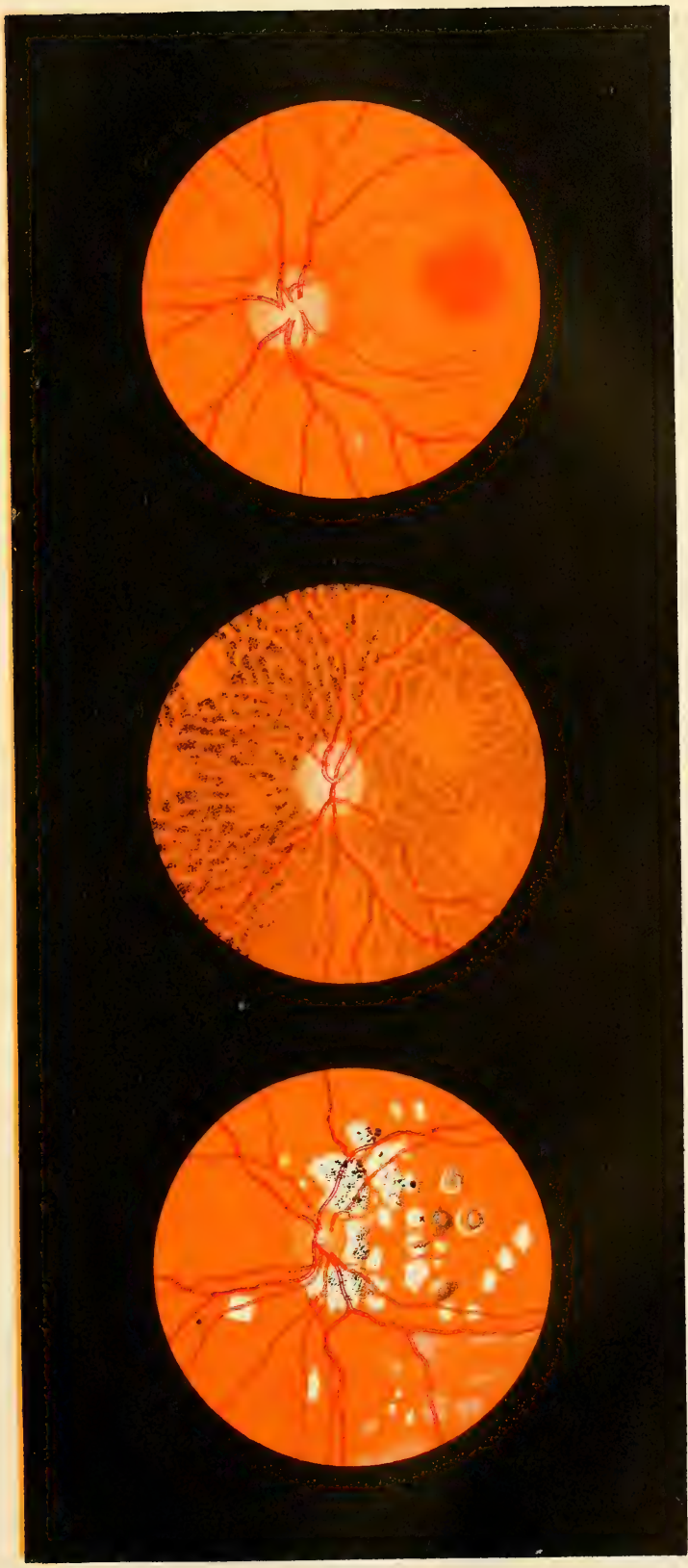


Fig.1.

Fig.2.

Fig.3.

LEBON & Co.

PLATE II.

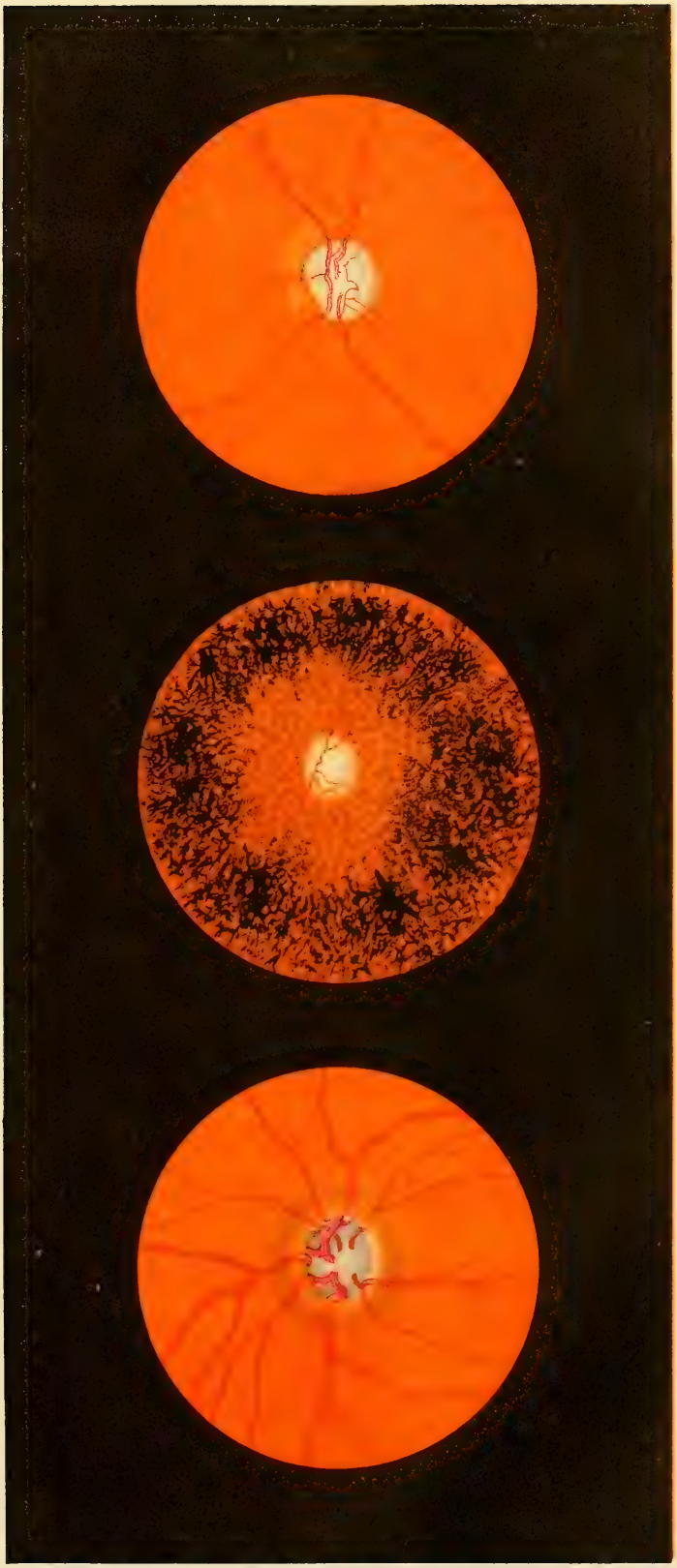


Fig. 1.

Fig. 2.

Fig. 3.

LEBON & Co.

DISEASES AND INJURIES OF THE EAR.

In the present article the natural division of diseases of the ear into those of the external, middle, and internal respectively, will be followed for the sake of convenience in describing them; but it will be observed that there are many abnormal conditions of the auditory apparatus which do not admit of so precise a definition; for, although in many diseases it happens that at first only one portion of the ear is affected, in the later stages of some affections two, and sometimes the three, divisions become involved in turn. This observation will be found to be true in the case of polypus and other morbid growths, acute inflammations which accompany the exanthematous fevers, disease of the temporal bone, syphilitic affections, and others which might be enumerated.

Examination of the Ear.

For a complete examination of the ear it is necessary that a threefold method should be employed. In the first part, the external canal and tympanic membrane are brought under observation; in the second, the degree of patency or obstruction of the Eustachian tube, and the normal or undue secretion within the tympanum, are estimated; by the third, abnormalities in the conduction or perception of sonorous vibrations are determined.

Fig. 6.—Hand-mirror.

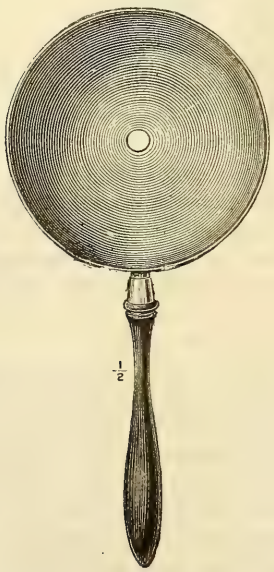
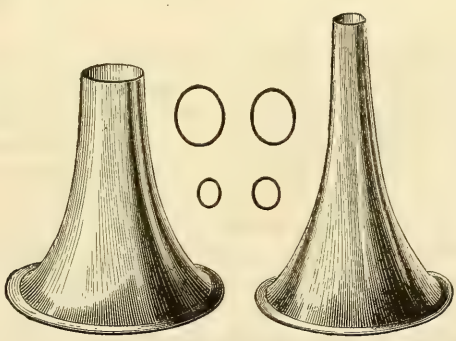


Fig. 7.—Ear Specula.



It is agreed amongst all practised observers that the external canal and tympanic membrane can be most satisfactorily examined by reflecting light from a concave perforated hand-mirror of eight-inch focus down a funnel-shaped speculum of the kind known as Gruber's; owing to the great variety in the calibre of the meatus, several sizes should be at hand. The patient, who must be seated close to a window, should have his head turned away from the light.

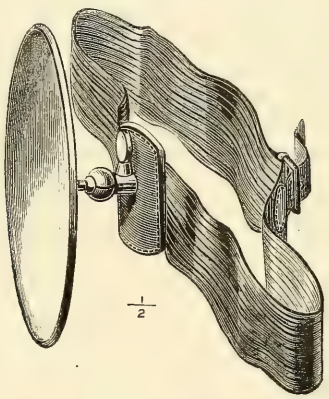
The speculum being then introduced, by moving it gently in different directions every part of the canal and membrane may be brought into view. Such movements are necessary on account of the curvature of the meatus, which winds at first a little downwards, then backwards, and slightly upwards, as far as the middle portion, beyond which it curves downwards until the tympanic membrane is reached.

If any manipulation or operative proceeding is required, the mirror fixed on the forehead by a band round the head must be used instead of the hand reflector. When bright diffused daylight is not obtainable, gaslight from an Argand burner affords perhaps the most convenient substitute. In passing, it may be remarked that the use of an ear speculum, being rather to afford a straight tunnel for light than to dilate the auditory canal (except under certain unusual conditions), it should not exceed altogether in length one and a half inches ; and, as it is desirable that the tubular portion should occupy as little space as possible in the canal, silver specula are better than those made of vulcanite.

The more or less perfect patency of the Eustachian tube may be diagnosed by the normal or abnormal appearances on the membrane which will be described under Affections of the Middle Ear.

The method of inflating the middle ear now in constant use is described by its inventor, Dr. Adam Politzer, as follows :—'The patient, being seated, takes some water into his mouth, to be swallowed at a given signal. The surgeon, placing himself

Fig. 8.—Mirror with frontal band.



conveniently to the right of the patient, grasps with his right hand an india-rubber bag, about as large as the two fists, and introduces the nozzle of a somewhat curved hard india-rubber tube, moveably connected with it, about half an inch into the nostril, so that its concavity is in contact with the floor of the nares. The signal is given to swallow ; both alæ are at the same time closed air-tight over the instrument with the thumb and forefinger of the left hand, and, by a forcible pressure of the right hand, the air is driven out of the bag into the now shut nasal cavity.'

Whilst inflation of the middle ear is thus practised, a piece of india-rubber tubing, of about three feet in length, should connect the ear of the surgeon with that of the patient under examination. Through this, the air as it passes into the tympanum may be heard to impinge upon the membrane (the patient is conscious of it so doing), and the state of the tympanic cavity in reference to secretion within it may be estimated.

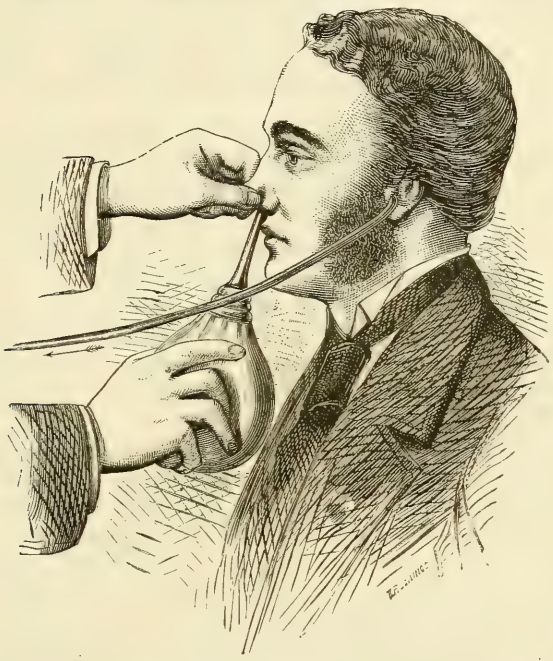
Of all the various tests for hearing which have from time to time been introduced, owing to the constant character of the notes which are produced, they are found to be serviceable only so far as they are a means of indicating changes in hearing from time to time. In order to obtain a comprehensive knowledge of the hearing possessed by a patient, nothing is equal to the voice, used at various pitches, and at varying distances. Each ear must be tried in turn whilst the other is effectually stopped, and the voice must come from directly behind the patient. If he can see the surgeon, the test is of course valueless, as he unconsciously aids the hearing by reading from the lips of the speaker. With adults they must repeat verbatim what is said, and with children the examination must be conducted by question and answer ; or, still

better, the child must not be considered to have heard till he has performed some movement or action at the request of the speaker.

To measure accurately a child's hearing, considerable patience is necessary, as when the deafness is extreme, children are so sensitive to vibration, that feeling is often mistaken for hearing. This applies especially in the case of absolutely deaf children, who will feel a piano playing, or a step into a room, so well as to deceive any one who is not experienced in their ways.

In the examination of adults, when the hearing has been generally estimated, the manner in which a vibrating tuning-fork is heard (when placed on the head) through the cranial bones, taken in conjunction with the examination of the external

Fig. 9.—Politzer's method of inflating the Tympana.



and middle ear, will enable the observer to appreciate in what degree respectively the conduction or the perception of sound is faulty. In some nervous affections the power of hearing very high notes should be tested by a Galton's whistle; but the details of these matters will be discussed more fully with the diseases on which they have especial bearing.

The External Ear.

Malformations of the external ear are with very rare exceptions associated with arrested development in the middle and inner ears. The whole subject is interesting rather from a physiological than a surgical point of view, except in so far that it often rests with the surgeon to determine in early life to what extent, if any, a child with a deformity of this kind is possessed of hearing power. The question as to what method of education should be pursued with a child must be decided by this. A rudimentary lobe often takes the place of the auricle, and the appearance of the lobe varies very much. Sometimes it is nothing more than a mere fold of integument; or there may be two, three, or even more, such appendages. It is noticeable that in almost all cases the position which should be occupied by the orifice of the meatus is marked with a slight opening just sufficient to admit for a short distance (perhaps a quarter of an inch) a small probe, and that from this exudes a slight thin discharge. Sir James Paget has pointed out that these openings are branchial fistulæ—are, in fact, 'due to incomplete closure of the upper or first post-oral fissure;

or, rather, of that part of it which is not utilised in the formation of the Eustachian tube, tympanum, and meatus.'[1] A very characteristic example of this deformity which I removed from a child in 1875, on account of its unsightly appearance, may be seen in the Museum of the College of Surgeons.

When the malformation of the external ear is great, for the reason above mentioned, the loss of hearing is generally absolute; but it occasionally happens that a child presents some lesser peculiarity, such as closure of the external canal by integument, and is possessed of so much hearing as to enable it to acquire language by the ordinary method, though not until much later in life than usual.

Surgical interference, even when there is considerable hearing, could only be contemplated in those cases in which the deformity seems to be confined to the closure of the canal; but this too often is but a small factor in causes which induce the deafness. It is only, therefore, under very exceptional circumstances that an artificial opening would be serviceable. When it has been made, it has been found very difficult to prevent reclosing of the opening, and the hearing has been but very slightly benefitted.

For anyone who has had the opportunity of observing great numbers of congenitally deaf children, it is difficult not to speculate on the possible influences which have aided in their production. Without any sort of doubt, a large proportion of malformations of the external ear, as well as congenital absence of some portion of the tympanum and labyrinth, occur in the children of parents who are blood relatives, and it is scarcely conceivable that these are mere coincidences. Because it is true that a large number of the marriages between cousins are productive of well-developed children, this in no way invalidates the other proposition, viz. that such intermarriages have the aforesaid tendency. My own conviction, as well as that of others who have been brought extensively into contact with the congenitally deaf, is very strong on this point.

In connection with the subject of deformities of the ear may be mentioned the occasional absence of the malar bone, or the zygoma, the substitution of solid bone for the external canal, absence of the tympanum, closure of the fenestra ovalis and rotunda by bone, absence of one or more of the semicircular canals.

Tumours of the auricle.—The so-called hæmatoma of the insane is a roundish red tumour which makes its appearance as an effusion of blood in the course of a few hours, and may be of almost any size up to that of a hen's egg. It is accompanied by heat and pain, and fluctuates. After a time the skin gives way, allowing the blood to escape, or, if not evacuated through an incision, the contents of the blood-cyst after a few months undergo absorption. In either case, but especially in the latter, the subsequent contraction leaves great deformity of the auricle. It is agreed on very high authority that these tumours need not necessarily owe their existence to blows or violence offered to the ears. The best account of them that has been published may be found in Dr. Rossa's work on diseases of the ear, in which the opinions of Virchow, Brown-Séquard, Hinton, and others are quoted. Swellings of a somewhat similar character and appearance occasionally may be met with on the auricle, when they are undoubtedly the result of violence. They are then nothing more than extravasations of blood.

A few instances have been recorded in which the auricle has been the seat of epithelioma. I have seen three cases of nævus in this part, and in all there was a flow of blood from them at the catamenial periods. They were readily destroyed by the electric cautery. Small simple cysts are occasionally found on the auricle, and the piercing of the lobe for earrings not uncommonly gives rise to small encysted swellings, which will not disappear unless they are removed. Calcareous deposits on the auricle in gouty people are familiar to all physicians. Their most usual position is on the upper border of the helix. They occasionally become inflamed, and are then very painful.

Foreign bodies in the ear.—Stones, beads, pieces of wood, berries, cherry-stones,

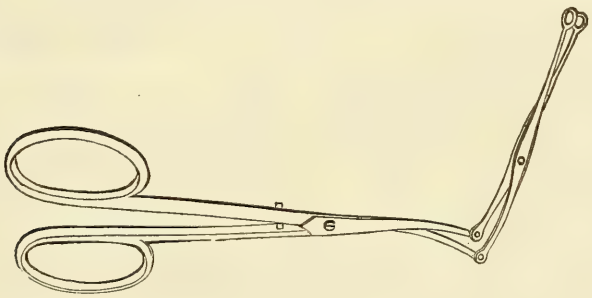
[1] See *Transactions of the Royal Med. Chir. Society*, vol. lxi.

or any other small objects which fall into their hands, are occasionally put into their own ears, or into those of others, by children at play, and if the occurrence escapes observation, they may remain in the ear for many years without exciting the least irritation or discomfort. When a foreign body has been introduced into the meatus, and has not been interfered with, it will be found in the first portion of the canal, and may be removed with tolerable facility; but, if an unsuccessful attempt has been made to seize it, or if the ear has been syringed in order to expel it, provided that it is small enough to pass the narrow middle part of the meatus, it will at once slip down the second portion, which takes a downward curve to the tympanic membrane. In this position it is by no means so easy of removal.

When light is reflected from the mirror worn on the forehead through a speculum, and the canal is then illuminated, the extraction of a foreign body, if it has not passed beyond the middle part of the meatus, may be effected without any pain or risk of injury to the membrana tympani. If this precaution is taken, but under no other circumstances, the operator may be allowed to select such instrument as the size, form, and general nature of the object may suggest.

In the majority of instances, perhaps the most useful instrument is a simple piece of steel, not thicker than a fine wire, and slightly bent at one end to form a very minute hook; the other end is fixed into a handle. With this little hook the foreign body can be drawn out. If the object present an edge that can be firmly grasped, a long polypus forceps may be used.

Fig. 10.—Forceps for extracting small Polypi.



Adults will sit still in a chair whilst this is being done, as they are not put to the slightest pain; but in the case of children, it is generally better to employ an anæsthetic, in order to ensure absolute stillness.

Should the foreign body, however, have previously been pushed beyond the narrow middle portion of the canal (and this fact is shown by an examination with the reflector and speculum), nothing beyond the most careful syringing ought to be resorted to. A very small nozzle to the syringe should be used and kept close to the upper wall of the canal; the head should be at the time so inclined as to facilitate the rolling out of the object. It is very much to be desired that the order of events in these cases could always be allowed to follow this simple and safe course; but, as a matter of experience, it very frequently is not.

No sooner is a child known or thought to have something in its ear, than the friends at once betray a burning anxiety to have it removed, and either they themselves endeavour to extract it, or some one else is found with sufficient hardihood to make the attempt without the employment of reflected light. The results are then invariably the same. If there is a foreign body, at the first touch it slips through the narrowed portion of the canal on to the membrane. A renewed attempt, accompanied by a movement of the child, ruptures the membrane.

That half, at least, of the patients who are brought to hospitals for the purpose of having foreign bodies removed from the ear are in this condition, and that of these many have had nothing whatever in the ear to partially justify the treatment to which they have been subjected, are matters of common knowledge amongst aural surgeons. It would be well if the ill-directed energy which is so often brought to

bear upon these cases ended with the simple rupture of the membrane; but the struggles of the little patients interfere so much with any further attempt to extract the foreign body (either real or supposed), that it is occasionally thought desirable to place them under chloroform, in order that a renewed groping in the dark may be conducted at leisure. The complete destruction of the membrane and contents of the tympanum is thus achieved. A passing allusion to such proceedings as being by no means of unfrequent occurrence may be pardoned, when it is remembered that the death of children under such circumstances takes place sufficiently often to be recorded in the journals and in recent works upon aural surgery. In the event of a patient in whom the membrane has been ruptured being brought for treatment, the meatus is swollen, and filled with blood, or discharge (if a few days have elapsed since the accident).

It will then be desirable to relieve inflammation with hot fomentations, and when all swelling has subsided, the ear should be syringed every day with warm water. Under such simple treatment, if there is a foreign body in the ear, it will generally come out, or in course of time be moved into such a position that by the means already mentioned it can be easily extracted. The purulent discharge from the ear will continue indefinitely until the membrane heals, which generally happens in course of time, unless it has been completely destroyed; and the extent to which the hearing is lost will depend upon the amount of damage done to the structures behind it.

Occasionally insects crawl into the meatus; syringing will remove them. If the auricular branch of the pneumogastric nerve happens to be situated rather superficially, and a small object remains without being discovered in the meatus, it is apt to excite irritation, and to give rise to a troublesome cough, which is at once relieved when the cause has been removed.

Exostoses.—Enlargements of the osseous portion of the external auditory canal are of frequent occurrence, and they afford on the one hand examples of the symmetry of disease, and on the other of the effects of a local irritation in producing successively increased nutrition and new growths. Thus, in passing under review a large number of these cases which have come under my own observation during several years, it is noticeable that in about half the number of patients who have presented themselves for examination, and to whom bony enlargements were present in one ear, upon inspecting the other ear it was found to be similarly affected, very often not only as to the size, but also as to the number of the growths. A very common form is that in which three enlargements meet in the canal. Sometimes there will be only one, at others two. Attention is generally directed to their existence by the fact of a piece of cerumen entirely closing an already nearly closed canal. Thus they may remain for many years without attracting notice.

In examples of this kind it is quite impossible to state with anything like accuracy the origin of the growths. Many explanations have been offered, such as that they are of gouty or syphilitic origin; but none of these views will bear the test of experience, nor can they be regarded as anything more than conjectural. I have seen several members of the same families the subjects of these bony enlargements, so that they are sometimes inherited. That they will at one time increase synchronously in either ear, that they will remain without apparent change for many years, that if they are uncomplicated with any further affection behind them they are harmless, and that the smallest possible aperture is sufficient for nearly perfect transmission of sonorous vibrations, are so many certain facts. But, if their existence is unaccountable in the one class of cases, their occurrence in the other admits of a tolerably accurate explanation. It often happens that a patient who complains of being deaf in one ear, and in whose external canal one or more bony growths are discovered, will be found to have suffered in early life for many years from a purulent discharge from the ear. The order of events will then have been—inflammation of the middle ear, perforation of the membrane accompanied with the discharge, healing of the perforation, abnormal growth of the osseous canal. Sometimes the perforation is still open, and the discharge may be observed to come from behind

the exostosis. The local irriation produced by the constant passage of this discharge from the open tympanum, especially when the opposite ear is absolutely healthy, appears in such examples to be a reasonable explanation of the origin of the bony growths.

When exostoses have been discovered, the patient should not be allowed at any time to put his head under water, as in bathing. A few drops of water, and especially of sea water, behind the growths are quite enough, not only to make him deaf, but often to excite irritation or inflammation in the neighbourhood or in the substance of the tympanic membrane. Indeed, it is this accident which frequently directs attention to the state of things. For the same reason, when the closure of the canal is completed by a small piece of cerumen, it is better to carefully remove it with forceps, or some appropriate instrument, rather than to syringe the ear. Inasmuch, as in most cases the canal is not absolutely closed, this management is all that is wanted in the way of treatment; but in the example above alluded to, viz. where the membrane is perforated, and in instances where the discharge cannot escape, where there is perhaps a polypus growing from the tympanum, and seen to be protruding between the exostoses, especially when this condition is accompanied with severe headaches and general constitutional disturbance—where, briefly, the patient is in immediate risk of blood-poisoning, or extension of inflammation to the cranium, the removal of the growth is urgently demanded. This is no easy matter, and the writer of this article has arrived at the conclusion, as the result of his experience of such cases, that the best method to employ is as follows:—The patient being under ether, and light being reflected from the mirror worn on the forehead, the bony growths are cut away by the drill which is in common use among dentists. It is, of course, necessary that an assistant should turn the lathe, and that the blood which oozes from the bone should be constantly staunched with absorbent cotton-wool. The bleeding of the bone, by obstructing the view of the parts, makes the proceeding necessarily a tedious one; but the complete command which can be exercised over the drill makes its employment in these cases most valuable. It is, of course, far more easy to remove these growths when they occur singly, as there is then generally a pedicle to cut through; and fortunately, when the enlargements have been the result of a local irritation, it is more usual to find the meatus completely obstructed by one tumour growing from the posterior wall than by two or three. They are of very dense structure like ivory. It is possibly a coincidence, though perhaps worth mentioning, that men are far more prone to this affection than women, and that they very commonly have been in the habit of bathing in the sea a good deal.

Accumulation of cerumen.—Were it not that accumulations of cerumen are very frequently directly and indirectly the cause of much trouble, a few words would be sufficient with which to dismiss the subject. As a matter of fact, however, the presence of cerumen may give rise to very serious consequences. For example, the tympanic membrane is not unfrequently ruptured by violent syringing entrusted to inexperienced hands.

Long-continued pressure from hardened wax occasionally causes ulceration of the membrane, and sometimes even absorption of portions of the osseous canal. Where very dry cerumen has been for some time in contact with the membrane, a few drops of water getting into the ear, by causing swelling of the mass, will so excite pressure as to set up inflammation within the tympanum, as well as throughout the entire external canal. It becomes necessary, therefore, on occasions, to exercise something more than ordinary prudence in the removal of wax from the ear. At other times the canal may be as nearly as possible filled with cerumen without any inconvenience arising from its presence, for the very smallest passage to the membrane will suffice or perfect hearing. When patients become deaf from this cause, they do so suddenly by some slight movement in the mass, occasioned generally by a little water getting into the ear, or by the pressure of the pillow on the tragus. It may be laid down as a rule that an ear should never be syringed unless an inspection has proved the necessity for such a proceeding. A stream of water directed on to the tympanic membrane can

only operate in a harmful manner, and it is by no means a very rare occurrence to find the membrane split vertically on one side or the other of the handle of the malleus, when a person has had the ear syringed by the first person whom he can induce to operate upon him. Even when the presence of wax has been demonstrated, and when it is, as often happens, of stony hardness, it is not always advisable to syringe the ear until the collection has been softened by soaking with warm water; for the first syringeful of water will perhaps drive the mass against the membrane, and it may, in its hardened state, be not very easily dislodged at the first sitting. In such a case it is better, even at the expense of a considerable time bestowed on the occasion, that the ear be kept filled with water for some time, and then that the secretion be subsequently removed.

At all times syringing should be employed with the greatest gentleness; the process ought not to cause pain, nor be continued for long at a time. If the above precautions are not attended to, a good deal of irritation may be set up, and the canal become so swollen that for many days it may be quite impossible to remove the cerumen. The most convenient form of ear-syringe is one in which the nozzle is removed (whilst the syringe is filled) and readjusted by a bayonet action. This portion ought to be small in order that it do not block up the canal, and when it is used, should be applied to the roof of the meatus. Its introduction will be much assisted if the auricle is drawn upwards at the time. A feeling of faintness and giddiness is at once produced if the water is not warm enough to be pleasant, and even then there will be found a certain proportion of people whom syringing the ears affects in this way. Indeed, as will be mentioned hereafter, the symptoms of giddiness, and sometimes even of vomiting, without any previous sensation of nausea, are prominent in many cases when either of the three divisions of the ear are disordered; thus showing the very intimate connection which exists between the pneumogastric and the auditory nerves.

Fungi in the meatus.—In 1867 Schwartze directed attention to the fact that the external auditory canal was occasionally the seat of a vegetable fungus, Aspergillus, and it has since been found by many others. The fungus is identical with that which is found in the mould on damp walls. When it has been noticed, it has generally been in cases where the canal has suffered from irritation, or collections of cerumen. It is easily eradicated by cleanliness and some local astringent, such as acetate of lead lotion, or spirits of wine.

Collapse of the cartilaginous part of the meatus is an affection of old age. The opening to the canal becomes often in elderly people reduced to a mere slit. When the hearing suffers from this condition, a small silver tube may be worn to keep the walls of the canal apart.

Eczema.—This is a very common affection of the external ear, and often involves the auricle as well as the external meatus. It is generally met with in persons of a gouty tendency, or those who become out of health from too free living and sedentary habits. In the acute form the whole of the external ear is very much swollen, red, and painful, and exudes a watery discharge, which dries rapidly, and becomes encrusted. The itching which accompanies it is most excessive. In this stage the best treatment consists in laxative saline medicine, given very freely; restrictions in diet, such as very little or even no animal food for a few days, and an entire absence of stimulants. The ear should be constantly fomented with hot water; the canal frequently syringed with warm water, and a lotion consisting of oxide of zinc and water may be dabbed on to the ear several times in the course of the day. When under this treatment the acute stage has passed away, an ointment consisting of vaseline and the ammonio-chloride of mercury, eight grains to the ounce, may be lightly pencilled over the ear and within the meatus.

The chronic form of the complaint requires the most patient treatment, and it is very desirable that the affection should not be allowed to go on without attention being paid to it; for not only does it lead to a general thickening and disfigurement of the auricle, but the integuments of the external canal become so much thickened that the passage is at last not infrequently almost occluded. When this disease has

been neglected for some years, I have often seen so much narrowing of the canal that it would only admit of the passage of a small probe. The hearing in such cases suffers very much indeed; for complete closure from the presence of a little dried discharge from time to time takes place. In cases of chronic eczema the first consideration is that the canal should be carefully syringed and dried. At first this ought to be done by the surgeon every few days, and the above-mentioned ointment very sparingly applied with a small camel's-hair brush. A rigid diet, suitable for a gouty person, must be enjoined. Some form of mineral aperient water may be taken in the morning, and a small dose of Liq. arsenicalis and bicarbonate of soda twice daily after food. Under simple treatment of this kind patients may completely recover from an otherwise obstinate and interminable disorder.

Boils in the meatus.—The external auditory canal is very often affected by boils, which are so persistent in their advent that it is not very uncommon to find a patient affected in this way, who will for many months not pass a week without a fresh one. No sooner has one boil completed its course than another begins. The first premonitory symptom is generally an intolerable itching. On account of this tendency to recurrence, no local treatment is of any avail until the constitutionally disturbing cause has been discovered and corrected. Strong vigorous men are quite as prone to this very troublesome affection (for the boils are extremely painful) as weakly persons. Men who, after being accustomed to very active exercise, take to sedentary pursuits, are unusually liable to this symptom, and therefore the treatment which was spoken of as being adapted for persons who suffer from eczema is generally in kind the most suitable for these cases. Some simple ointment, such as zinc ointment made with vaseline, will be useful to relieve the itching.

Abscess of the canal requires more vigorous treatment. It is an intensely painful affection, and is very often set up by the irritation of cerumen behind the spot where it forms. It is generally best to open an abscess in the canal, for the integuments are so tense that much prolonged suffering is in this way avoided; and the incision should be made very freely, if it is needed at all. What is generally described as *diffused inflammation of the external auditory canal* occurs more or less whenever the tympanum is also inflamed; it is then confined chiefly to the soft parts of the canal, and the movements of the jaw are very much impeded; but if it is of primary rather than of secondary origin, the periosteum is the tissue affected. In the latter case the canal appears very much swollen, and it is very tender. If the pain, which is extremely severe, does not subside after leeches have been placed in front of the tragus, and followed by fomentations, an incision should be made through the periosteum. This may be conveniently done with a curved bistoury, and the incision should be made as the knife is withdrawn. Unless this relief is given to the extreme tension of the parts, some portion of the osseous canal will afterwards die, and exposed bone in this situation is most troublesome; for it not only is difficult to detach and remove, but from the exposed surface granulations arise which fill the meatus; there is then a profuse purulent discharge from the ear. These granulations become afterwards dignified by the term polypus, and if they are simply removed, will be reproduced very soon afterwards.

In the treatment of this condition, therefore, as in the case of true polypus or any other morbid growth, extraction is merely the preliminary step to treatment. To accomplish their removal the ring polypus forceps may be employed, or any modification of this instrument that the ingenuity of the operator may suggest. Indeed, it is absolutely necessary that several instruments should be at hand, for not only does the meatus of individuals vary very much in calibre, without any reference to the ages of patients; but the size and position of the growths are sufficiently different to suggest the most convenient instrument for their extraction. After the removal of a polypus, or of granulations, some caustic fluid should be applied to the point of origin which is connected with the diseased bone. Chloro-acetic acid is of all others perhaps the most useful, since its action can be immediately stopped, if necessary, by syringing; for this acid is perfectly soluble in water. The best plan of applying the acid is to twist a very small piece of absorbent wool on to

the end of an eye-probe, and moisten it with the caustic. For daily use afterwards, powdered gallic acid may be applied. Of course, complete recovery does not take place until the whole of the dead bone is removed.

The Middle Ear.

There are certain points in connection with the middle ear which make it as impracticable as undesirable that the subject of diseases to which it is liable should be treated in so divisional a manner that it might be supposed possible to speak exclusively at one time of affections of the membrane, at another of the cavity of the tympanum, or at another of the Eustachian tube. For in practice it is found that the tympanum cannot suffer without the membrane being altered in appearance and structure; that abnormal states of the membrane are for the most part secondary to catarrhal or inflammatory changes within the tympanic cavity; and that any obstruction of the Eustachian tube, from whatever cause arising, not only alters the curvature of the membrane, but also, as a natural consequence, the position of the chain of ossicles which lie across the tympanum. In short, one division cannot suffer without involving, more or less, the other two.

The patient study of the tympanic membrane in disease cannot fail to leave two distinct impressions on the mind of the observer: first, that any alteration in its appearance or structure must be regarded chiefly as an index of changes which have taken place within the tympanic cavity rather than as important in themselves; secondly, that any preconceived notions as to the functions of the tympanic membrane must be often discarded, seeing that such perfect hearing is sometimes present with a membrane as different from health as it is possible to conceive, whilst, on the other hand, extreme degrees of deafness, exclusively dependent on disease of the tympanum, will be found to be associated with nothing more marked than a loss of lustre and translucency in the membrane. It must not be supposed, however, that the most careful study of the membrane in health and disease is likely to prove barren in its results, for the contrary is true. The most trifling alterations in curvature, and the most minute variations from health, especially when these signs are taken in conjunction with the opposite ear of the patient under examination, and the history of the malady, will often form an incident in the chain of evidence which will throw so much light upon the subject under investigation as to make what would otherwise be an obscure case, one readily understood in all its bearings. Thus, a small scar on the membrane will occasionally tell a story of previous inflammation within the tympanum, the details of which had long since passed from the memory of the patient or his friends. It seems almost needless to observe that the appearances presented by a healthy membrane must be, in the first place, perfectly familiar to the student of ear diseases, and perhaps the first thing that he will notice will be the considerable variations which are found to exist in the brightness, translucency, and curvature of the membrane in individuals whose ears are absolutely healthy. No description will fully illustrate this fact, and it is a knowledge only to be attained by a large experience. Speaking generally, however, the chief points to be observed in the membrane are the following:—

(1) The *short process of the malleus*, which forms a projection at the upper and middle part of the membrane.

(2) Proceeding downwards, and slightly backwards, and terminating at a little below the centre of the membrane, the *handle of the malleus*.

(3) Taking the termination of the handle, or umbo (as it is called), for its apex, and extending downwards and slightly forwards, is *the triangular bright spot, or cone of light*. This is an area from which, when the membrane is illuminated, light is reflected back to the eye. It is due to the peculiar curves exhibited by the membrane; curves which are of a somewhat complicated nature, and which are dependent on the conditions that might be expected to obtain when it is remembered that this stretched membrane has an oblique position, forming with the floor of the canal an angle of about 45°, and that it is drawn upon by the handle of the malleus,

which is tilted inwards. Thus, although it is irregularly concave at the centre, its peripheral part is somewhat convex. It will be noticed that this cone of light would be absent if the membrane were a plain surface, and that, as a matter of observation, its position is altered by movements of the handle of the malleus, produced by distending the tympanum with air, and by the removing this distension by the act of swallowing.

(4) *Its colour*, perhaps best described as blue grey, which varies even in health according to its transparency, for under the influence of a very bright light the tympanic cavity is more or less illuminated. The colour is also influenced by the kind of light which is employed, being more blue under sunlight and of a somewhat yellowish hue under the artificial illumination from gas.

(5) *Its lustre*, which is soon lost whenever the tympanum is affected with catarrh or inflammation, as it also is in many affections of the external canal.

(6) *Its inclination.* This varies somewhat; it forms an angle of about 45° with the floor of the meatus.

(7) *Its curvature* presents irregularities, the reasons for which have been previously mentioned, and it also will be found, as will be mentioned later on, to alter in all cases where the middle ear is affected.

For surgical purposes it will be sufficient to remember that the tympanic membrane, consisting, as is well known, of external radiating fibres, derived from the periosteal covering of the external meatus, and internal circular fibres from the periosteum of the tympanum (between these the handle of the malleus is fixed), has, as an external layer, a continuation of the skin of the meatus, and that its internal layer is the extremely delicate mucous membrane which lines the tympanum and the Eustachian tube.

Injuries of the membrana tympani.—The membrane is very frequently ruptured accidentally. This may happen from the introduction of any pointed instrument into the ear; by the violent compression of air within the tympanum, as in vomiting or blowing the nose; by the sudden compression of air within the meatus from a box on the ear, or an explosion near the ear; by a blow or fall on the head; or by a violent syringing. In whatever way the accident occurs, a sudden acute and sickening pain is felt, and this is immediately succeeded by a feeling of faintness. There is perhaps also a little oozing of blood. Even without an examination, the precise nature of the accident may be known by the facility with which the patient can pass the air through the tympanum in a forcible attempt at expiration, whilst the mouth and nose are closed. After the accident, the membrane either heals in the course of a few days, or suppuration is established in the tympanum. There is then a purulent discharge from the ear. But, even if this takes place, the tendency of the membrane is towards healing. When the ear is examined soon after the accident, a clot of blood will sometimes be observed covering the rupture, or the opening may appear like a slit, the edges of which separate if the patient blow through the perforation. Where a sharp pointed object, such as a toothpick, a twig of wood, or the like, pierces the membrane, the wound generally heals very rapidly (in a few days), and very little deafness is ultimately left. Although subsequently the perforation may close; if suppuration has once been established, in some degree, however slightly, the hearing suffers. The function is more extensively injured after rupture, caused by blows on the head or ear, and by explosions, than by any other form of the accident. In truth, however, in these cases, as in all others, the rupture *per se* has very little indeed to do with the loss of hearing, as may be noticed from the fact that shocks of this nature are alike productive of very serious and permanent deafness, whether the membrane be broken or not. In both cases the nervous structures are, without doubt, the parts which mainly suffer. After suppuration in the tympanum, however, a second element comes in, for the products of inflammation within this cavity still further damage the hearing by their interference with the conduction of sound to the labyrinth. Conclusive evidence of the degree in which the nervous portion of the ear is damaged on the one hand, and the conducting portion on the other, is afforded by comparing the manner in which the vibrations of a tuning-fork placed upon the

vertex are heard relatively by the injured and the uninjured ear. Where the nervous power of the ear is damaged, such vibrations will be heard less loudly than in the healthy ear, and more loudly when the conducting power has been impaired in the course of inflammation within the tympanum. It is worthy of notice that far greater damage is done to the hearing by a box on the ear or explosions when they come unexpectedly—*i.e.* before the tensor tympani muscle has contracted so as in some degree to prepare the membrane for the shock. In accounts of the injuries under consideration, which I have given elsewhere,[1] will be found an instance in which the portio dura was injured in its passage through the aqueduct of Fallopius, by the point of a pair of scissors thrust through the membrane (complete paralysis of the facial muscles instantly followed), and in the twenty-two cases there recorded 'the perforation did not heal in ten; in six instances the hearing did not suffer at all; in the remaining sixteen it was more or less seriously impaired.'

The chief treatment for accidental rupture of the membrane is to prevent the patient putting anything (even water) into the ear, so that the healing process may be allowed to take place without being interfered with. If suppuration takes place, nothing more should be done than gently to syringe the ear with warm water, taking care that occasionally secretion from the tympanum is expelled by causing the patient to blow through the opening. If it does not heal eventually, the case will come within the category of ordinary perforation of the membrane, to be mentioned hereafter, and must be treated accordingly.

The importance of non-interference in these cases cannot be too urgently impressed on the patient, and it is somewhat rare to find instances (unless the patient is seen soon after the accident) in which some sort of an attempt has not been made to assist the healing process which so readily takes place if it is allowed to proceed unmolested. How quickly the membrane heals may be seen at any time if it is examined within a few days of an occasion on which it has been ruptured by a blow or fall on the head which has been followed by some bleeding from the ear. Even in those cases in which the bleeding has been profuse, and in which there has been every reason to believe that the base of the skull has been fractured, the healing process is not very long deferred. The appearance which is presented when the membrane is ruptured from these causes is very generally a longitudinal slit in the anterior or posterior section of the membrane. On one occasion when the accident occurred from the explosion of a gun close to the ear, I observed two slits on either side of the malleus, extending from the top to the bottom of the membrane; they both healed completely within four days of the accident.

In the case of a severe blow or box on the ear, when the hearing is extensively damaged, it generally recovers to a certain extent, and this happens quite irrespectively of any rupture of the membrane. The loss of hearing is always accompanied by more or less tinnitus, and this symptom is the last to disappear, and indeed is sometimes persistent for the remainder of the patient's life. It is very much to be desired that it should be generally known how commonly the practice of boxing boys' ears at school is sometimes followed by most serious and permanent deafness.

NON-PURULENT CATARRH OF THE MIDDLE EAR.

The term catarrh as applied to the middle ear includes in their early stages all the affections to which it is liable, and when it is remembered that the Eustachian tubes and tympana are lined continuously with the same tract of mucous membrane, which is in all cases the part primarily involved, the application of this term is a very natural one. So long as the increased secretion is merely of a mucous character, the disease is spoken of as non-purulent, but if the process of congestion passes into that of inflammation, and the formation of pus takes place, the term purulent catarrh is applied to the affection. This division is not so artificial as would appear at first sight, for although the one may be sometimes merely the first stage of the other, it is found in

[1] Vide *Transactions of Clinical Society*, vol. vi., and *Lancet*, 1875.

practice that the middle ear may for years be affected with increased secretion of its lining membrane, without ever suffering from inflammation in the true sense of the word.

Obstruction of the Eustachian tube.—In the simplest form of catarrh, nothing more than the faucial openings of the Eustachian tubes are involved, and the symptom complained of is deafness, accompanied by a sensation of weight in the ears. It is a very common ailment with children and young persons, and whilst the so-termed strumous are more liable to it than others, it is by no means confined to this class. More often than not it is associated with a granular condition of the pharynx and posterior nares. For this reason the subjects of it present a very characteristic appearance, since they breathe almost exclusively through the mouth and more habitually during sleep. The temperate damp climate which prevails in this country and Germany is peculiarly favourable to its development. In children with this complaint the hearing varies very much according to atmospheric influences and the especial locality in which they reside. Thus a clay soil is especially unfavourable to these patients; also they hear much better in summer than in winter; and if they remove into a dry warm climate, recovery occasionally takes place without further interference. Under ordinary circumstances it is of primary importance that the condition of the nares should be attended to, and this may be done by the daily syringing of the nostrils with alkaline or saline solutions. Salt and water, sea water when obtainable, or a solution containing carbonate of soda, borax, and sugar, are amongst the most suitable. The fluid should be warm, and must be syringed in such a manner that it passes chiefly through one inferior meatus of the nostril and out through the other; and whatever of it passes into the throat must be spat out. In this way large masses of secretion will be brought away, and after a time free breathing through the nose is established. This plan is much to be preferred to the nasal douche, the use of which is without doubt not free from danger. When it is employed, it occasionally happens that some of the fluid passes through the Eustachian tube into one or other tympanum, and sets up inflammation, which ends in rupture of the membrane, accompanied by more or less disorganisation.

The subjects of this catarrhal malady, especially when they are of a strumous type, often have enlarged tonsils. Although the tonsils do not mechanically in any degree close the Eustachian tubes, they keep up the unhealthy condition of the pharynx, and interfere with the respiration. They should then be removed. When it is added that Politzer's method of inflation ought to be occasionally practised, the routine of treatment has been indicated. This simple and useful proceeding is a very important element in the successful management of a case, not only because it instantly improves the hearing, but because it relieves the extreme tension to which the membrane is subjected when the tympanum is not constantly replenished with air. It may with benefit be repeated at intervals; but, insomuch as its employment is extremely grateful to the patient, it is necessary to guard against its abuse. It is unfortunately sometimes practised with too great violence, and has often within the writer's experience caused sudden rupture of the membrane. Its too frequent use also tends, by stretching the membrane, to cause its permanent relaxation.

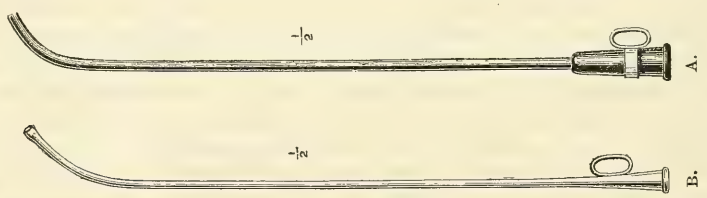
From whatever cause the Eustachian tube is obstructed, the membrane presents in a degree the same appearances. They are such as might be expected when air in the tympanum, not being regularly replenished, undergoes partial absorption. For whilst the density within the middle ear is in this way diminished, that of the outer air remaining the same, pressure is produced on the membrane, and on the chain of ossicles which rotate with its movements. In an extreme case the short process of the malleus will seem to be bursting through the membrane; the handle is tilted backwards till it is almost in contact with the promontory, and the central concavity of the membrane is much increased.

From the short process proceeding horizontally backwards in the posterior section of the membrane may be seen a ridge or fold evidently produced by the altered position of the malleus, since it disappears after inflation of the ear has been practised. The condition of the posterior nares already referred to is very often the result of scarlet fever or measles. Obstruction of the Eustachian tube may take place

in adults, even in good health, and apparently without any predisposing cause beyond an ordinary cold, and it is quite in accordance with experience to find one tube affected as often as both. If attention is directed to the matter before it has been of long duration, a few inflations and the use of some simple saline syringed through the nares, will suffice to remove the obstruction ; but, unless some relief of this kind is afforded within a reasonable time, the use of Politzer's method will not succeed in opening the tube, and it then becomes necessary to make use of the Eustachian catheter. This instrument (the employment of which is mainly useful for injecting fluid into the tympanum in cases of catarrhal affection of this cavity) may be made of silver or vulcanite. The latter kind can be bent to any curve required by slightly warming, and then allowing them to cool whilst the necessary curve is maintained by the hand.

Three or four different sizes are enough for ordinary use. The purpose served by the metal ring is to show the position of the instrument in passing it—that is, whether the point is directed to the left, the right, downwards or upwards. The other end receives the india-rubber bag which is employed in injecting air or fluid into the middle ear. The mode of passing the catheter is as follows :[1]—'Place the patient in a chair, and let him lean back in it ; steady his head with the left hand, firmly fixed on the top of it ; hold the catheter lightly in the right hand, with the curve downwards, and pass it quickly in this position through the inferior meatus of the nose to the posterior wall of the pharynx. When this is felt, withdraw the

Fig. 11.—A. Vulcanite Eustachian Catheter. B. Silver Eustachian Catheter.



catheter about half an inch, and tilt the point of the curved end rather upwards and to the left or right, according to the side which is being operated upon. Now hold the catheter and end of the patient's nose steadily between the thumb and the first two fingers of the left hand. All this time the ear of the patient and surgeon are connected by the diagnostic tube. The point of the catheter is now supposed to be in the pharyngeal opening of the Eustachian tube ; but the only certain sign of this being the case is that, when air is forced into the catheter, it will be heard through the diagnostic tube to impinge upon the tympanic membrane when the stream of air is passed down the catheter (I am presuming that the Eustachian tube is not occluded). This is the most common method of using the catheter, and I think it is the best.'

After some little practice the mistakes which are made by those not in the habit of using this instrument will be avoided. They consist chiefly in not keeping the point of the catheter in contact with the inferior meatus, and so passing it into the middle meatus, and in not withdrawing it far enough before turning it outwards. The proceeding, although unpleasant to patients, is not painful, and they for the most part soon become so tolerant of it, if it is passed rapidly, as not to object to its use. With others the nostril is so sensitive as to make it always most unpleasant. The real difficulties which are met with consist in the facts that the septum of the nose in some persons is not placed vertically, but inclines to one or the other side, generally to the left, and that the inferior turbinated bone is occasionally much larger than usual. The meatus is then quite impassable for even the smallest instrument. In these cases it is sometimes possible, by greatly increasing the curve of the catheter, to introduce it through the opposite nostril. Patients who require the employment

[1] Vide *Lectures on Diseases of the Ear.* Dalby.

of the Eustachian catheter frequently, should be provided with one for their exclusive use, and this, for obvious reasons, should be the invariable rule if they are the subjects of constitutional syphilis.

When Politzer's inflation has failed to open the Eustachian tube, the catheter will generally succeed. It is necessary to repeat the operation at intervals until the middle ear becomes habitually filled with air without artificial means. The complete inflation will be often aided by placing a drop or two of warm water in the open end of the catheter after it is in position and before the bag is compressed. It is probable that the manner in which this acts is by dislodging some small particle of mucus. In some cases of extreme obstinacy in which the Eustachian tube has been obstructed for many years, the introduction of a small laminaria bougie through the catheter will sometimes effectually relieve an otherwise intractable condition. It is necessary to bear in mind that where this method is employed the bougie must be measured, and the distance thought desirable to pass is marked before it is inserted into the catheter, or it might unwittingly be passed into the tympanum; the extent of one inch (the length of the cartilaginous portion of the tube) will be sufficient, or at the most one inch and a quarter. After it has remained in situ for a few minutes, the catheter and bougie ought to be withdrawn simultaneously, as, unless this is done, the latter might break off and be left in the tube. This accident is mentioned by the late Mr. Hinton as having occurred twice in his practice, and although no evil consequences ensued, the fragment coming away on the next day, it is clearly important that the risk of this occurring should be avoided. The cases in which this somewhat severe treatment is necessary are not very numerous, and require a rather careful selection; for when the tube is so effectually closed to the entrance of air, this condition is often associated with old adhesions in the tympanum, the remains of inflammation which has taken place in previous years; the admission of air to the tympanum will not then effect the relief which, in the absence of tympanic disease, might ensue. The history of the case and the appearances of the membrane will, however, decide this question.

Affections of the tympanum.—The tympanum may become the seat of catarrh, by extension from the Eustachian tube, or the lining membrane of the cavity may be primarily affected. In either case the results are the same, both in kind and in the effects which they produce on the hearing by interfering with the conduction of sound. In the early stages of this disorder the swelling of the lining membrane effectually prevents the entrance of air into the tympanum. Increased secretion more or less fills it with mucus, and, in addition to the aforementioned signs of obstruction which the membrane exhibits, its translucency is lost. The presence of secretion within the tympanum may be recognised by the sounds that are heard through the diagnostic tube when air is forced into the middle ear with a Politzer bag; and that the deafness is dependent on faulty conduction can be at once shown by a simple experiment with the tuning-fork. If, whilst in a state of vibration, this is placed on the vertex, the sound will be heard exclusively by the affected ear. This arises from the fact that vibrations through the cranial bones make their impressions on the labyrinth without the aid of the tympanum, and that, in their passage outwards through this cavity, they become again reflected by the obstruction on to the nervous structures.

In this hypothetical case the opposite ear is presumed to be healthy. Whilst on this subject, it may be as well to observe that the value of experiments with the tuning-fork as an aid to diagnosis depend on the following facts.

(1) Let a vibrating tuning-fork be placed upon the vertex of a person with good hearing, and it will be found that he hears the sound quite equally with both ears; that when he can hear it no longer, if it be held near to the meatus, the sound is still plainly audible, thus showing the value of the tympanum as a conducting apparatus.

(2) If, whilst a vibrating tuning-fork is on the vertex, one meatus be closed, the sound will be heard most intensely or entirely in this ear. The same result will

[1] *Questions of Aural Surgery.* Hinton.

follow if there is cerumen in the canal, or, as was explained, if there is mucus in the tympanum, or, in short, if there is any obstruction to the passage of sound through the conducting media.

(3) A person in whom the nervous function of both ears is defective will hear the tuning-fork on the vertex indifferently, or not at all, and, if one ear only is thus affected, he will hear it exclusively in the normal ear. In estimating the advantages of this test, it is well to remember that occasionally persons with apparently good hearing do not readily hear a tuning-fork placed on the vertex; but such instances are so exceptional that they scarcely need be taken into account.

In a recent and slight attack of tympanic catarrh, the main object of treatment is to keep the cavity occasionally replenished with air, until all catarrhal symptoms have subsided. If this is carefully done, a complete recovery may be expected; but in actual practice the patient seldom consults the surgeon at so early a period, and it is frequently not until some months have been allowed to elapse, or after several attacks, that the case comes under observation. In the course of one or more of these there will probably have been considerable, or even intense, pain in the ear. Whenever this occurs, the results are more or less serious on the hearing; and it may be accepted as a rule in treatment that, if the tympanum can be said to be inflamed (and it always is when there is pain), leeches should be applied in front of the tragus, and fomentations be afterwards continued until the pain is gone. The importance of attention in this direction can hardly be over-rated; for, without any sort of doubt, catarrhal inflammation of the tympanum is, in the results which it leaves, an infinitely more frequent cause of impaired hearing than any other disease of the ear.

These results include occlusion or obstruction of the tympanic opening and the Eustachian tube; thickening of the lining membrane of the tympanum, collections of moist or dry mucus which form around the ossicles, adhesions between the ossicles themselves or between these and the tympanic wall, adhesions connecting the membrane with the several parts of the tympanum, anchylosis of the ossicles, changes in the tympanic membrane such as chalky deposits, relaxation and collapse of the membrane, thinning in parts of its substance, and, when suppuration has taken place, perforation or entire loss of the membrane, and, lastly, caries of the bone.

Opacities of the membrane, whether in the whole or part of its area, are significant only of the fact that at some time or other the tympanum has suffered from catarrh; and since it is quite possible that at the time of the examination the tympanic cavities may have entirely recovered, the appearance is observable in persons of good hearing power as well as in those with whom it is deficient.

Extensive *calcareous deposits* (which consist of phosphate of lime) are also very frequently met with in the membranes of persons with normal hearing. When, therefore, this form of degeneration is accompanied with failure in the conduction of sound, the impairment of hearing must be regarded as depending upon disease of the tympanum, and not, as might from a superficial examination be supposed, upon the alteration in structure of the membrane itself. The constant occurrence of calcareous degeneration, when it is found to be associated alike with normal hearing, with absolute deafness, and with all intermediate stages, very completely disposes of the notion which was formerly held, that 'thickening of the membrane' is a common cause of deafness; and when it is a matter of knowledge amongst those who see large numbers of cases that nearly perfect hearing may exist when the membrane has been almost entirely lost by ulceration, it is time that the views which are popularly held as to the functions of this structure should undergo some modification. If to these facts are added the record of cases in which the membrane has been accidentally ruptured without any appreciable loss of hearing power, and of others where pressure on the malleus is capable of changing most defective to excellent hearing, it is not giving too much credit to pathology to say that the functions of the tympanic membrane are better understood than they were, owing to the study of its diseases. It might be permitted to the present writer to express the opinion that, whilst the province of the membrana tympani as a medium of the conduction of sound must be regarded as very slight, its uses as a protection to the tympanic

cavity, and as a ligamentous support to the chain of ossicles, ought to be considered as its principal functions. Although these calcareous deposits can (as has been said) be seen in otherwise healthy ears possessed of good hearing power, they are more commonly present after the tympanum has been at some previous period acutely inflamed; so that, if in the former case no precise explanation of the existence can be given, they are in the latter, without doubt, a form of degeneration depending on inflammation.

Relaxation and collapse of the membrane are amongst the results of long-continued catarrh. There is no question but the presence of mucus within the tympanum, by long-continued pressure, will cause thinning in places of the substance of the membrane, and thus bring about a condition of relaxation; but the extreme examples of this state are generally induced in the following manner. When a patient with chronic obstruction of the Eustachian tube discovers or is told that he can increase his hearing by forcing air into the tympanum, he acquires the habit of doing this whilst he closes his nostrils with his hand. Patients will get so entirely into this habit that they will practise it more or less all day whilst they are conversing or listening to anything. The result is that the membrane becomes stretched to such a degree that with each inflation it bulges outwards, and in a few moments can be observed (if it is submitted to inspection at the time) to drop backwards again. Sometimes the membrane, under the constant repetition of this practice, becomes so thinned as to exhibit upon inflation bladder-like protrusions. This very characteristic appearance is not uncommonly brought about by the injudicious use of a Politzer Bag. I have myself constantly seen it in the case of young people whose friends, fancying that they have discovered a method by which they can cure the child, have made a daily practice of using the air douche, and in doing so have applied far greater force than is necessary or prudent. On some occasions when the membrane in this state is being subjected to pressure, the thinned portion gives way, and soon after the admission of the external air a purulent discharge is established and escapes through the perforation. Even in the less extreme cases, the air douche should be at once discontinued, and a small disc of moistened cotton-wool be adjusted on to the membrane and worn for a part of a day; its effects are sometimes most beneficial in restoring the membrane to a more healthy tone, and giving the support which had been lost to the malleus. In the relaxed and thinned state of the membrane, acquired either in the above-mentioned manner or by the prolonged pressure of mucus upon its internal surface (as might be supposed when the middle ear is not distended with air), it falls back on the posterior wall of the tympanum, and becomes more or less completely collapsed; adhesions form between it and the promontory, and the incus, and sometimes the stapes, can be distinguished behind it.

Accumulations of serous fluid and mucus often remain for considerable periods in a more or less fluid state within the tympanum. For these cases it is occasionally of the utmost benefit to the hearing if a vertical incision be made with a cataract needle behind the malleus, and the mucus be expelled through the cut by the patient blowing through it, or by the use of the air douche. The late Mr. Hinton was in the habit of syringing from the meatus through the tympanum and Eustachian tube by means of a syringe, the nozzle of which was made to fit tightly in the external canal. This proceeding, however, sometimes sets up irritation in the tympanum. The plan is certainly not so much in favour at the present time. After the expulsion of the secretion, the cut heals in the course of two or three days. The indications for the employment of this operation are the squeaking, bubbling sound which may be heard through the diagnostic tube whilst inflation is practised, as well as the bulging and discoloration of the membrane produced by the secretion. Patients with this affection will often hear much better whilst lying down. This is owing to an alteration in the position of the mucus, as, on resuming the erect position, the deafness at once returns.

When what may be called the dry state of the tympanum has been reached in cases of old-standing catarrh—that is, when the fluid portions of any increased

secretion have undergone absorption, when the inflation of the middle ear gives no improvement; when, in short, the failure in the conduction of sound is due to a thickened state of the lining membrane of the tympanum, and the other changes within it that have been spoken of as the results of catarrhal inflammation, the treatment which has the most beneficial effect upon the hearing is the injection of fluids into the tympanum through the Eustachian catheter. When the catheter has been passed in the usual manner, it is steadied with the left hand; about thirty minims of the solution are passed into the open end by a glass syringe or a pipette, and if the india-rubber bag, elsewhere spoken of, is now applied and compressed, some of the fluid may be heard through the diagnostic tube to pass into the tympanum. The fluid does not all pass into the tympanum, since it leaves the catheter in the form of spray; so that there is no danger if this plan is adopted of the fluid being in such quantity as to sink down into the floor of the tympanum and excite irritation. The cavity becomes bathed rather than filled with the fluid. The solutions which are found to be most useful are those composed of bicarbonate of soda or iodide of potassium, about five grains to the ounce of warm water, or simply warm water. The injection should be practised for a time daily, or two or three times in the week, and the air douche should be used occasionally. That a very considerable proportion of cases improve under this treatment experience amply proves; but it is not very easy to say in what way these injections precisely act. Possibly the dried mucus becomes softened under their influence, old adhesions give way, and a beneficial influence is exerted upon the lining membrane of the cavity. After this treatment has been pursued for some time, improvements in hearing sometimes suddenly occur, so that it is fair to conjecture, under such circumstances, that adhesions do give way, or that some movements take place in the morbid secretion which has become softened. This method of treatment seems especially suited to a class of cases which have been described by Dr. J. Gruber, under the title of Proliferous Inflammation of the Tympanum, and this term has since been adopted by many writers upon ear disease. The patients who suffer from it can give no precise history of catarrh of the pharynx or nares; the symptoms of deafness and tinnitus are gradual and progressive; the Eustachian tubes are pervious, and air enters the tympanum with a dry sound. A most detailed account of the pathology of this affection may be found at page 514, 'Ohrenheilkunde,' Wien, 1872. Sufficient to say that the changes therein described include in succession hyperæmia of the lining membrane, increase of connective-tissue corpuscles, hypertrophy, and granular formations which undergo molecular disintegration, become fatty, and are absorbed or become chalky.

It is right to mention that the practice of injecting fluids into the tympanic cavity has been abandoned by many surgeons of high repute, and the causes for this abandonment have been stated by them to rest upon two very sufficient reasons—viz. first, that the results have not proved satisfactory, and, secondly, that the cause of the failure in treatment is probably due to the fact that inspissated mucus or other products of inflammation are absolutely insoluble in any of the fluids which can or have from time to time been made use of. The fact of this insolubility is undoubtedly true, and it can only be urged in favour of the practice that, in a certain number of cases, patients undoubtedly receive benefit, and that in such instances this benefit probably is not due to the solvent powers of the injected fluid, but rather to their action upon the tympanic cavity, to which reference has just been made.

It is also not very easy to explain the precise manner in which the fumes of muriate of ammonia act upon the lining membrane of the middle ear; but it is certainly true that such treatment of chronic catarrh of this tract of mucous membrane is often in the highest degree useful; and patients who have been taught how to apply the remedy will continue it for long periods, at intervals, of their own accord, because they derive considerable relief from its employment. The fumes of muriate of ammonia may be readily applied to the tympanum by means of a most simple inhaler made for the purpose. The fumes of ammonia, acting upon strong hydrochloric acid, are drawn through water by means of a piece of glass tubing, as in smoking a

pipe, whilst the mouth is filled with the fumes; by attempting to forcibly expire (the mouth and nose being closed at the time) the whole of the middle ear is acted upon by the muriate of ammonia.

A brief reference has already been made to the much-debated question of operations which involve an incision in the tympanic membrane, and I have contented myself with saying that, where there is distinct evidence of serous or mucous accumulation within the tympanum, if a vertical incision is made in the posterior section of the membrane, and the secretion is evacuated by blowing through the cut, very great benefit to the hearing constantly follows.

An account of disease of the ear could not be considered to be otherwise than incomplete if mention were not made of operative proceedings on the membrane, which have been recommended and practised by continental surgeons.

In approaching this matter, it may be observed that the literature of the subject is voluminous in the extreme. Still the most scanty history of all the operations which have been devised and practised would be out of place in this article unless results could be brought forward such as would justify the performance of similar operations in ordinary practice. The class of cases for which they have by their respective advocates been suggested are the so-termed proliferous catarrhal affections of the tympana, and the object in view has been twofold: either to make a permanent opening in the membrana tympani, or by an incision in this structure to relieve undue tension. The nearest approach to the first result was attained by Dr. Adam Politzer, who, after making an incision in the membrane, inserted an eyelet into the opening. This may be readily done by the forceps made for the purpose; but it is found that, after a few weeks, or months at the most, the eyelet either drops into the tympanic cavity or the meatus, and the opening eventually heals. Some years ago, in common with many others, I made use of this method, but without any permanently satisfactory benefit. Voltolini's paracentesis by the galvano cautery, Gruber's flap in the membrana tympani, Lucass's and Politzer's incision of the posterior fold of the membrane, Prout's division of adhesions between the membrane and promontory, besides other proceedings of a similar kind which have been dignified by the term operations, when stripped of their pretentious nomenclature, are neither more nor less than incisions into the membrane, which heal in the course of a few days. In 1868, Dr. T. A. Weber, of Berlin, first divided the tendon of the tensor tympani muscle, and in 1872, and subsequently, he published accounts of the results of this operation.

Fig. 12.—Knife for making incision in the Tympanic Membrane.
(Handle in figure half the length.)

I think it but right here to say that it is not without a very large personal experience of operations on the tympanic membrane in the cases under notice that I venture to express my opinion on the position which they should hold as remedial measures, and I should still hesitate to do this if I were not fully aware that it is an opinion which is shared by the leading aural surgeons in America (in which country otology has been most extensively and successfully practised), and, with few exceptions, by those in Europe.

Up to the present time the results of all the various operations have not been equal to the expectations which were formed of them. So far as concerns those which have had for their object a permanent opening in the membrane, they have signally failed, and this has been due to the great tendency to repair which the membrane possesses.[1] Where incisions have been made, and allowed to heal without

[1] An account of an operation by M. Paquet, of Lille, may be seen in the Transactions of the International Medical Congress of 1881 held in London. He divides the tensor tympani muscle, and attempts a permanent opening in the membrane, with perhaps better success than has hitherto been attained.

any interference, considerable benefit has followed in a certain proportion of the cases operated upon, in others none at all. As to the division of the tendon of the tympani muscle, it cannot be doubted that it would by this time have become an established operation if its results had proved sufficiently satisfactory. It would be too much to say that this is the case. Ample opportunities have been given to surgeons of seeing patients upon whom this has been practised, and the operation has been performed by others besides its originator.

We have, at any rate, become familiar with the fact that an incision may be made into the membrana tympani without danger to life, or injury to the hearing, so long as before the operation the nervous structures of the ear are unaffected, and it is earnestly to be hoped that some surgical procedure may in time be found which shall have more brilliant results than those which have hitherto been attempted.

If I were to express my own view of the causes which may be said to have improved the hearing where this change has happened, I should say that tension has been relieved, and that adhesions between the membrane and the tympanic wall have been divided—adhesions the existence of which it has been impossible at the time to do more than conjecture. It will readily be understood, therefore, how difficult it must be to lay down any rules by whose guidance the surgeon may select cases in which he may deem it advisable to make an incision into the membrane.

To say more than this might be misleading, and nothing less than a considerable experience in successes and failures will be likely to lead to good averages in a number of cases treated by any operation which includes incision of the tympanic membrane. One of the best opportunities of comparing the opinions of the leading otologists of Europe and America on the subject occurred at the International Medical Congress in London in 1881. On that occasion the principal countries of Europe and the United States were most fully represented, and there could be no question but that the general opinion was of no more definite a character than the one which I have here ventured to express, when the question as to the 'Value of Operations, in which the Tympanic Membrane is incised' was discussed; and let it be here said that this question was discussed in the most exhaustive manner.

INFLAMMATION OF THE TYMPANUM.

The cavity of the tympanum very commonly is the seat of inflammation during some one of the exanthematous fevers, especially in scarlet fever and measles, by extension of inflammation from the fauces. An ordinary catarrh of the middle ear may merge into inflammation, or the tympanum may become acutely inflamed quite irrespectively of the Eustachian tube. At all times, in consideration of its occasionally terrible results, this affection must be regarded as a most serious one. In the case of the fevers, it is so rapid in its progress, and the importance of the general state of the patient so engrosses the attention, that it generally escapes observation until the membrane has given way, when a purulent discharge points to the ear complication. In a person of ordinary health, the first symptom is acute pain, which soon becomes of a throbbing and agonising character, deeply seated in the ear, and sometimes extending over the side of the head. The membrane is, on inspection, seen to be of a bright red colour, and after a few hours appears to be much collapsed and sodden. The act of swallowing is painful, and if inadvertently air is blown into the ear whilst the patient uses his handkerchief, the pain is intense. There is considerable deafness and tinnitus. The temperature is heightened, and there are general feverish symptoms. If at this period leeches are applied in front of the tragus, and hot fomentations freely used, the acute symptoms may subside without the membrane giving way, and more or less complete recovery take place afterwards under the treatment for ordinary catarrh of the middle ear. Should there be a distinct appearance of bulging in the membrane, an incision in this spot for the evacuation of pus ought to be made at once. It more commonly happens

that the membrane has become perforated before the patient is seen, and there is a discharge. Then the main object of treatment is to induce healing of the open tympanum. The ear should be syringed frequently during the day with nothing more than warm water. All astringent solutions ought to be sedulously avoided. They are extremely painful to the recently exposed surface of the tympanum; they retard, and often altogether prevent, closure of the rupture, by inducing cicatrisation of the edge of the perforation, and they increase very much the symptom of deafness. As the purulent discharge becomes less in quantity, and more thin in character, it is desirable that the patient should blow gently through the perforation whilst the ear is being syringed. Accumulation of secretion in the tympanum is thus avoided, and it is the presence of such collections which retards the healing process. Under this extremely simple management many quite recent perforations heal. The tympanic membrane, supplied so plentifully as it is with blood-vessels, has a great tendency to heal, and this is abundantly shown in the cases of infants and young children. What is more common with little children than severe pain in the ear, followed after some hours of evidently acute suffering by a discharge from the ear—discharge which, after lasting for some days or weeks, gradually ceases! I have in common with others found, times out of number, the discharge to be dependent on a perforation of the membrane; and, upon examining the ear some months afterwards, seen the membrane perfectly entire. I may here be allowed to say that I feel confident that the convulsions of children are often due to brain irritation from an inflamed tympanum.

But, if a perforation does not heal within a short period of its establishment, it may remain indefinitely as a fistulous opening, and frequently does, during an entire lifetime. The sizes and shapes of perforations are various in the extreme. Sometimes the loss of substance is so small as only to represent a small opening, such as might be made by a pin, whilst at others the entire membrane is lost by ulceration, the malleus being left in its natural position, or the head of the bone only remaining. Between these, an almost endless variety.

Still, the forms which perforation assume exhibit a certain uniformity. Thus, a very common appearance is that in which the perforation involves the lower half of the membrane, and is kidney-shaped, the hilus of the kidney being represented by the extremity of the handle of the malleus. Sometimes one-half of the membrane is deficient, the handle of the malleus forming the median border of the opening. Or circular portions of the membrane are seen in either the anterior or posterior section, which have the appearance of being punched out. Especial attention should be always directed in examination of the membrane to the folds of membrane which lie in front and behind the head of the malleus, at the upper border of membrane—minute perforations in these positions are liable to escape observation. They are very unmanageable, since purulent secretion within the tympanum escapes through them with great difficulty, and I have often found that they are associated with diseased bone. The edges of an old perforation very generally present an unhealthy granular appearance, and granulations are likely to extend over the external surface of the membrane. In this case on a first examination one may readily fancy that much more of the membrane is deficient than really is so, and if parts of the membrane thus covered are connected to the posterior wall of the tympanum, the aspect is still more delusive in this respect.

The loss of hearing in perforations of long standing bears no kind of relation to the amount of tissue which has been destroyed in the ulcerative process. Intense deafness with a minute perforation, and fairly good hearing when little of the membrane remains, are as commonly met with. As previously intimated, extensive observation in this, as in all other states of the membrane, conclusively proves that the symptom of deafness depends upon disorganisation within the tympanum, excepting so far as loss of the membrane has interfered with the function which it fulfils of being a ligamentous support to the chain of ossicles. In the treatment of old perforations the same careful attention should be given to cleanliness as in recent ones, and the use of strong metallic astringents be guarded against. Their

employment may certainly have the effect of lessening the discharge, and so raise delusive hopes as to permanent benefit; but no sooner are they given up than the discharge is as copious as before. They increase the symptoms of deafness, occasionally give great pain, and that they exercise no permanently beneficial influence on the exposed mucous membrane of the tympanum is shown by the fact that persons of large experience in the treatment of ear disease are scarcely ever found to recommend them. Amongst local applications, perhaps the most useful is a weak solution of alcohol. About one drachm of rectified spirit to three ounces of water is strong enough to commence with, and the proportion of spirit can be gradually increased so long as it does not cause pain.

This application seems to be especially suitable to children. If the membrane is largely perforated and covered with granulations, under the use of gallic acid in powder the condition of the ear is often much improved. But the treatment which supersedes all others in value is the application of some form of covering to protect the tympanic cavity from the action of the external air. To carry out this successfully, the patient must be taught to construct and apply with forceps a piece of moistened cotton-wool of the size and form which is found by experiment to be most comfortable, to afford the most complete protection, and to give the best results in hearing. Improvement in the latter direction is often very extensive, and the principle which is involved is the same as in all the forms of artificial membrane (so called) that have been suggested and used since the time of M. Toynbee. It consists in the fact that pressure is exerted upon the malleus, and so on through the incus, to the stapes. Thus the natural support to the chain of ossicles, which has been lost when the membrane has suffered from ulceration, is in a measure restored, The ingenuity in this application acquired by patients is very remarkable, and they are able to discover, after some practice, the precise amount of pressure required. The local effect upon the ear which follows the exclusion of air from the tympanum is not the least important part of the proceeding. Under this influence the discharge very generally becomes reduced to a minimum, and granulations, if present, disappear. Of course this plan of treatment is not applicable to children or very young persons, who can neither acquire the necessary skill nor will exercise the requisite care and perseverance. The artificial membrane (of Toynbee) is rather irritating, and the india-rubber disc is very liable to break off the wire and become fixed in the tympanic cavity. I have on a great many occasions been requested to remove it after this accident. In the case of perforations which have existed for many years, if under favourable circumstances, the ear becomes more healthy, large portions

Fig. 13.—Forceps for adjusting Cotton-wool.

of the membrane are restored, even to the extent of one-half or more. It is impossible to predict this event in any case, and the fact that this does take place becomes known only when opportunities, which are occasionally met with, of seeing patients with an entire membrane, who, by reference to a case book, were known to have a perforation some years previously. When the healing process once sets in, to judge by what takes place in cases of recent perforation, it is completed in the course of a few days. Scars on the membrane are sometimes represented by calcareous deposit, or, where large portions of tissue have been restored, the position of the perforation is seen to be occupied by what is evidently a much thinner part of the membrane than the rest,

Facial Paralysis.—When inflammation of the tympanum has been so extensive as to result in necrosis of that part of it in which the portio dura is imbedded, the nerve occasionally becomes destroyed, and permanent facial palsy takes place. But a moderately severe pain within the ear, lasting perhaps for only a few hours, not followed by rupture of the membrane, and leaving only a slight and temporary

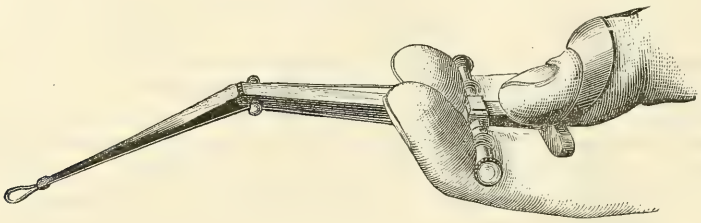
deafness, is not unfrequently succeeded by complete facial paralysis, and a period of many months elapses before the muscles regain their original power. That this serious lesion should follow on so apparently a trivial cause appears to be due to the fact that the bony protection to the nerve in its passage through the aqueduct of Fallopius varies very much indeed as regards its thickness in different individuals, and it is in those cases where it is exceptionally thin or perforated by minute holes, as it sometimes is, that a slight degree of inflammation is sufficient to arrest the functions of the nerve. The old-fashioned plan of blistering the mastoid process, if ineffective in other affections of the ear, appears to have a decidedly beneficial influence on these cases. The blisters should be applied at short intervals for several months. The application of electricity to those cases in which the nerve has the capacity, so to speak, of recovery has proved of very great service.

Polypus of the ear.—The appearance presented by a polypus which protrudes from the meatus is that of a fleshy tumour. It bleeds when it is touched, and is attended with a purulent discharge. The seat of origin is sometimes the meatus, usually the posterior wall. It is then very often connected with diseased bone, and after its removal the tympanic membrane may be found to be healthy. Most frequently polypi have their origin in the lining membrane of the tympanum, and are brought into existence by the continuous discharge from a perforation. In the ordinary form they are in structure fibro-cellular, the fibrous element predominating in proportion to the age of the growth, and in their microscopical characters exhibit an appearance very like fibrous tissues in the course of development. Some growths which I have removed have been found to present the characters of myxoma, containing in parts elastic fibres, and in the case of a tumour which had recurred on thirteen occasions after removal, it proved to be a round-celled sarcoma. A polypus may not only fill the canal and protrude from the ear, but may cause absorption more or less of the bony part of the canal meatus. The membrana tympani has very generally been lost by ulceration before the beginning of the new growth, but a small polypus may sometimes be noticed protruding through a perforation of even moderate size, showing, without further demonstration, from whence it must spring. Occasionally, though very rarely, polypus grows from the edge of the perforation. The treatment of a polypus consists in its removal, complete eradication, and in the management of the perforation, such as has been already described. Unless the two latter portions of the treatment are very rigorously carried out, it is absolutely useless to take away a polypoid growth. No sooner is it removed, than it at once begins to grow again, so that, unless the patient is prepared to give some time and trouble to the after treatment, the surgeon will do well in not undertaking the case. The ring polypus forceps, of which a number of sizes should be within reach (on account of the variation in the size of the meatus, and the position and form of the growth) is the best instrument to employ in extraction of a polypus; but, as a matter of fact, the instrument which is used is of secondary importance. The appearance of the growth, a careful examination with a probe, the facility with which the pedicle (if there is one) can be grasped, will suggest the most convenient instrument: so that a Wilde's snare, or any of the many forceps which have been devised, may be employed according to the fancy of the operator. In practice the tumour is often found to be so friable that it is necessary to take it away bit by bit. This is not of any importance so that it is completely taken away, and occasionally, in consequence of the bleeding, several sittings may be required. The root should be carefully destroyed with some of the caustics. Perhaps of all these the most manageable is chloro-acetic acid, since its action can be stopped at once by syringing with warm water. Before any application is used, the surface should be most carefully dried with absorbent cotton-wool, so that the acid may not act on any part except the root. So long as this is done there is no pain, but the slightest touch of caustic on the exposed mucous membrane of the tympanic cavity is most painful, and is liable to set up considerable irritation. Indeed, the application of any caustic within the tympanum by unskilled hands is not free from danger.

A sharp-pointed piece of wood, or a few fibres of wool wrapped over the end of

a fine probe, are convenient for this purpose. After the growth has been thoroughly destroyed, the exposed surface of the tympanum should be protected from the air as in a case of ordinary perforation. Since polypi may become indirectly the cause of death, by preventing the escape of discharge from the tympanum, and so giving rise to blood-poisoning or meningitis, it is generally desirable to remove them as soon as they are discovered; but when the external ear is in a state of inflammation, and no urgent symptoms, such as pains in the head, are present, some delay may be allowed until the swelling of the canal has subsided under treat-

Fig. 14.—Wilde's Polypus Snare.



ment; for under such circumstances they cannot be entirely taken away, and interference at such a time is apt to excite rather than to allay the already existing irritation. Excepting under such circumstances, if the size of a polypus is such as to afford any impediment to the free egress of discharge, I cannot refrain from expressing the opinion that the risk of delay should in all cases be pointed out to patients. Within my own knowledge several deaths have occurred from meningitis which can be directly traced to a polypus blocking up the tympanum, and they took place in the case of patients who, with a full knowledge of the state of the ear, elected, contrary to advice, to put off the operation for a time.

Abscess in the mastoid process.—Communicating so freely as they do with the tympanum, and lined by a continuation of the same membrane, it is somewhat surprising that the mastoid cells should not more frequently become affected in the course of inflammation of the middle ear than they do. When they are inflamed, it is generally by extension from the tympanum; but I have very often seen abscess in the mastoid process, the tympanic cavity remaining meanwhile unaffected. Children are more liable than grown-up people to mastoid complications. With them intense pain, redness, swelling, tenderness, and œdema on pressure, are generally soon followed by fluctuation, and a free incision succeeded by a discharge of pus completes the list of symptoms, and necessary treatment. If considerable œdema, accompanied by constitutional disturbance, remains for several days even without fluctuation being discoverable, it is always more desirable to make an incision down to the bone, and break into the cells (which is readily done) than to delay the evacuation of pus. In the case of adults, however, although frequently a mastoid abscess is a simple affair, sometimes owing to the extreme thickness of the bone the matter cannot make for itself escape externally. The condition then becomes very serious. It is peculiarly characteristic of the presence of pus within the mastoid cells that the pain becomes agonising when the patients lie down. If this symptom has continued for some days, if there is constant pain and marked œdema on deep pressure, if the temperature is heightened, the tongue furred, and, lastly, if there has been a distinct rigor, no time should be lost in making an opening through the bone into the cells. To accomplish this, at the distance of about one-inch from where the ear joins the head, a long vertical incision is made down to the bone through the periosteum. A sharp-pointed perforator like a gimlet may be used, if no better instrument is at hand; but what is much preferable is a drill, the depth to which it is desirable to perforate being regulated by a moveable stop, so that the precise distance which is being bored can be seen. This requires to be considerable, and the bone is very hard. A probe should be, occasionally during the operation, inserted into the wound to determine if the cells have been reached. When this

has been accomplished, a few drops of fœtid pus will be seen to well up through the wound. The proceeding, which naturally requires to be conducted with considerable care, occupies some time, so that an anæsthetic must be employed. On the day after an operation, if the patient forces air into the middle ear, whilst both meatus are firmly closed, a quantity of discharge can be expelled through the opening. The complete relief which follows perforation of the bone, the subsidence of the urgent symptoms, and other general considerations which will at once suggest themselves, are sufficient without further comment to point to the extreme necessity for its employment under suitable circumstances. I have adopted this treatment in a great number of cases, and I feel justified in expressing the opinion that, if it is carried out sufficiently early, blocking of the sinus and its sequel of blood-poisoning may be frequently avoided.[1]

Sometimes, instead of following the directions hitherto named, after suppuration within the mastoid process the purulent matter makes a route under the scalp or into the tissues of the neck. In such instances, when it is practicable, the most efficacious method of managing the case is to make use of a drainage-tube in such a manner as the condition may suggest.

Fatal results of inflammation of the middle ear.—It must be allowed then, whenever the lining membrane of the tympanum has become the seat of suppuration, there is a certain degree of danger to life from extension to the brain and its membranes, or from pyæmia; and if any part of the bone is diseased, the danger is no doubt much greater. This is shown by the results of post-mortem examination. But a large number of deaths occur in one of these ways when the bone is found to be perfectly healthy. If inflammation extends from the mastoid cells, it is more usual to meet with pyæmia than with cerebral abscess or meningitis. From my own observations, however, I feel confident that no rule can be laid down as to the direction which inflammation may take, should it start from the tympanum. When this happens, it is quite as common for a patient to die of blood-poisoning as from cerebral complications. In all cases the most premonitory symptom is a severe rigor. This is soon followed by an elevated temperature, increased frequency of pulse, furred tongue, and the usual indications of fever. When the brain or its membranes are affected, there is intense pain in the head, which continues until the patient finally becomes comatose. In meningitis the patient lies tossing his head from side to side, moans, delirium is a prominent symptom, and the course of the disease is generally rapid. But when an abscess forms in the substance of the brain, there is sometimes very little delirium, and the patient may linger for a long time, even for several weeks. The post-mortem appearances which are met with in this class of cases include the following:—Lymph or pus beneath the arachnoid, between the bone and dura mater, communicating with the tympanum. Pus passing from the tympanum into the labyrinth, through the internal auditory canal, and so to the cranial cavity; abscess in the substance of the cerebrum or cerebellum, the sac of which communicates with the tympanum or abscess in the substance of the brain with healthy brain tissue between the wall of the abscess and the temporal bone; blocking of the lateral sinus and jugular vein, accompanied with scattered abscesses in various parts, in the lungs chiefly, or pus in the pleural cavities.

In recalling to my mind, or referring to the notes of cases which I have seen, where death has occurred as a direct result of inflammation in the middle ear, it would not be difficult to divide them into two classes, very distinct in many ways from each other. In the smaller class of the two, the subjects have been apparently healthy, and without any affection of the ear until within a very few days of their death.

In consequence of a cold, or for some other reason not easy of explanation, they have been seized with acute pain in the ear, which has been soon followed in rapid succession by rupture of the membrane, discharge from the ear, rigors, and the constitutional symptoms just described. In the other and far larger class, there has been a perforation of the membrane, with more or less discharge from the ear, for many years. I have on several occasions known patients, who have been said to

[1] Vide *Med. Chir. Trans.*, vol. lxii.: 'Diseases of the Mastoid Bone.'

have had a discharge from the ear for over forty years, to be seized with a rigor, and die in the usual course without, so far as could be ascertained, any accidental cause which might excite fresh irritation in the tympanum. What happens on such occasions, irrespectively of any noticeable change in the state of the ear, may, in other cases to which reference has already been made, be traced to the blocking up of discharge by polypi, and this affords, if it were needed, an additional and urgent reason for the removal of these growths.

It must not be supposed that, in every instance where alarming symptoms show themselves in connection with a perforate tympanum, the termination is fatal. Intense headaches, attended with feverish symptoms, a rise in temperature, and cerebral irritation, are not very unusual with patients of this class. Under enforced quiet, leeches, and fomentations to the ear, these symptoms sometimes pass off and recur at intervals. The precise pathology of these cases becomes more clear from post-mortem examinations of persons who, with a perforation of the tympanum, have died from other causes. In these the dura mater overlying the tympanum has been found much thickened. Personal observation has for many years made me attach very great importance to pains in the head (often spoken of as neuralgic) with those who are the subject of perforations. Where there is evidence of diseased bone, as proved by examination with a probe, the importance is increased immensely. It would hardly be too much to say that these people are in great danger. In many instances where I have known the patients to die of cerebral complications, I have found a note of head pains, as having been complained of many years previously. Amongst those who have survived after complications of tympanic inflammation must be reckoned the recoveries from empyema, and pyæmic abscess in various parts of the body.

Perforation of the tympanic membrane is so common a disease, so many persons pass through long lives without any more serious trouble from the perforation than partial deafness and an occasional discharge from the ear during an ordinary cold, that the element of risk which surrounds the lives of the subjects of this lesion is apt to be disregarded, until attention is suddenly directed to the subject by the somewhat unexpected and generally unavoidably fatal termination of a case. It is impossible for anyone to have large numbers of cases of ear disease brought under his observation without a certain small proportion of them being composed of these fatal cases. Considering the frequency with which a perforation is found on examination to be accompanied with disease of the temporal bone, it is a matter of surprise that more deaths do not occur from this cause. There is no doubt that hundreds of persons in whom there is disease of the bone in that part which contains the tympanum, pass the chief part of a long life without any serious complication in consequence of it, whilst, on the other hand, at any moment, without any appreciably exciting cause, the train of fatal symptoms may commence. The same observation will hold good even when the perforation is uncomplicated with bone disease. Sea-water has a most irritating influence upon a perforation, and so often is the cause of an attack of inflammation in the tympanum, that everyone with this affection should be warned against sea-bathing. I have known several instances in which fatal symptoms would seem to have been excited by this irritant.

Malignant disease of the ear.—The history of malignant disease of the ear is the same as that of polypus, and the appearance which it presents in the early stages is precisely similar—a new growth originating from the local irritation of a purulent discharge from the lining of the tympanum. The form which it assumes is epithelioma. It is a somewhat uncommon affection; I have only seen three examples of it. In each of these large portions of the temporal bone were destroyed in the progress of a cancer. The immediate cause of death in two was exhaustion, in the other hæmorrhage from the lingual artery. In the cases which have been recorded the discharge had lasted for many years. The single exception to them, so far as I know, was the second case which I saw, and in this the discharge had only been present for five months, and was originally induced by an accidental rupture of the tympanic membrane by a hair-pin. With a few of the patients only

whose cases have been placed on record a predisposition towards cancer could be said to have existed.

Necrosis and caries of the Temporal Bone.—As a result of inflammation in the tympanum and mastoid process, portions of the temporal bone may often suffer from necrosis and caries. The ossicles come away in the discharge, large parts of the external canal and mastoid die, and it is surprising to how great an extent this may happen without causing the death of the patient. On one occasion, after making an opening into a large fluctuating swelling over the mastoid process of a child, I readily removed with my fingers so large a piece of dead bone which was loose, that, upon examining it afterwards, it seemed to represent nearly the whole of the temporal bone. The wound healed, the external ear sank into the deep pit, which was left, and the child completely recovered its health.[1] It is also not at all unusual for large portions of the external auditory canal to come away or to require removal. The extent to which the hearing power becomes lost when the temporal bone is the seat of caries, depends of course upon the part of it which is affected. If that division which forms the cavity of the tympanum is involved, the deafness is very generally total, and the portio dura is paralysed.

SYPHILITIC AFFECTIONS OF THE EAR.

Inherited syphilis.—The occurrence of partial or complete loss of hearing in the subjects of inherited syphilis has become familiar to all since attention was first directed to it by Mr. Jonathan Hutchinson. It is most important that the ear should be examined in every case which presents itself, for it is quite possible that, unless this is done, the results of catarrhal inflammation, which may exist quite independently of syphilis in these patients, may escape observation.

Irrespectively of such possible complications, a considerable number of the subjects of inherited syphilis become deaf. That the affection is strictly a nervous one may be shown from the fact that the hearing is occasionally entirely lost in the space of a few weeks; for there is no possibility of these symptoms existing to so severe an extent as a result of tympanic disease without absolute destruction of the tympanum and its contents, which would, of course, be recognised by the usual methods of examination. Whilst some become totally deaf from this cause, others retain during their whole lives, a considerable degree of hearing power, and a period of several months is generally occupied before the greatest measure of deafness (whatever it may be) is reached. Usually the symptoms begin in early life, and sometimes in childhood; but adult life is often reached before the changes which produce it commence. What portion of the nervous apparatus becomes affected cannot be said to be accurately known; but the probabilities are strongly in favour of the cochlea being the seat of the disease. This presumption is likely to be correct, from the fact that in the commencement the very high notes are lost much sooner than ordinary sounds, such as the voice. As this affection of the ears is a very common one with children, it is frequently the cause of deaf-mutism.

Constitutional syphilis affects both the nervous and the conducting portions of the ear. During the course of secondary symptoms syphilitic patients very often become deaf, without any disease of the external or middle ear, and recover under constitutional treatment. The loss of hearing is symmetrical, and vibrations through the cranial bones are either heard badly or not at all. If the hearing becomes affected in the case of a person who, after having passed through the various phases of syphilis, is evidently not free from the disease after several years, it is scarcely ever regained, and is then most probably due to permanent intracranial changes.

In syphilitic ulceration of the fauces, the Eustachian tubes and tympanum sometimes become affected, and it then becomes necessary to employ the remedies suitable for catarrh, in addition to the ordinary constitutional treatment. In instances of this kind I have known the tympanic membrane to be ruptured, and the external

[1] Vide *Med. Chir. Trans.*, vol. lxii.

ear to be filled with syphilitic mucous tubercles. The same has happened on several occasions in the case of patients who, whilst suffering from a perforated membrane, have become syphilised. The ordinary purulent discharge from the ear having become imbued with the syphilitic poison in its passage over the meatus has caused the growth of the mucous tubercles. The local treatment is the same as when they appear in other parts.

Disease of the Nervous Portions of the Ear.

Owing to the impossibility which exists of examining during life the nervous portions of the ear, the question as to whether they are in a state of health or disease must be settled chiefly by negative evidence and by the history of the case. This is not so difficult a matter as might appear at first sight. A patient becomes suddenly or gradually deaf, and suffers from tinnitus; if, upon examination, it is found that the external and middle ear are healthy, and if the vibrations of a tuning-fork cannot be heard through the cranial bones, it may be safely concluded that the disease is of a nervous character. Even when opportunities are given to examine the ears of persons deaf from nervous causes, and who have suffered severely from tinnitus, there is often no change which can be truly said to be of a distinctly definite character. This is not surprising when it is remembered that a complete loss of function in nervous tissue may exist without any absolutely discoverable alteration in its structure.

The morbid changes which have been noticed are chiefly hyperæmia of different parts of the labyrinth; supposed excess or diminution of otoconite, atrophy of the membranous labyrinth, chalky deposit in the meatus internus, atrophy of the auditory nerve. These conditions are of course quite exclusive of the congenital deficiencies in various portions of the labyrinth, which are met with in those who are born without hearing. Syphilis, blows on the head, and explosions near the ear have already been mentioned as immediate causes of failure in nervous function. There are several others which require notice. As is well known, it very commonly happens that the hearing is permanently and entirely lost during many of the fevers, no portion of the external or middle ear being at any time the seat of inflammation. The same occurs, not uncommonly, during an attack of mumps, when one or both ears may become affected to such an extent in the course of a few hours as to leave the patient absolutely deaf. This irremediable loss of hearing takes place in the case of young children with sufficient frequency to place mumps in the list of acute disorders which are the causes of acquired deaf-mutism.

Putting aside the circumstances which have already been mentioned as immediately attendant upon, and evidently as direct causes of nervous disease of the ear, there remain very large numbers which are, it must be admitted, more or less surrounded by obscurity. In order to, in some measure, dispel this, it seems to me, in the present state of our knowledge, there is nothing likely to prove so satisfactory as a careful attention to all the details in the history of every case which comes under notice. For anyone who will take sufficient trouble over a series of years, it would become quite possible to arrange cases into groups, each group having characteristics which make it quite distinct from the rest. A mental classification would be thus made by observing a uniformity in disease. It is to be hoped that the time is not far distant when each class will be found to be associated with a definite morbid change in some portion of the labyrinth or course of the auditory nerve. At present it is but a simple statement of the truth to say that this is not the case. What, it might be asked, is the precise lesion which accompanies complete or partial loss of hearing in persons of vigorous health when they are subjected to violent emotional influences? I have known a healthy woman to become instantly and totally deaf on the discovery of the unexpected death of her husband; the same to happen to a young girl on the receipt of a telegram informing her of the death of her father; to a mother on witnessing an accident to her child; or to a

woman on seeing the suicide of her husband; to another on being frightened by an alarm of fire. Many other disasters might be named as having been instantly followed by extensive and permanent deafness. In a minor degree the anxious care and devotion with which some women watch and nurse their relatives during a long illness leaves occasionally, amongst other ailments, a loss of hearing and tinnitus; whilst in the case of men, prolonged mental strain is sometimes followed by the same symptoms.

Other examples of nervous disease of the ear belong to a class which have, for want of a name, and certainly for no better reason, as far as I can see, been termed Menière's disease; for, in the two cases related by Dr. Menière, and from which the name has been derived, both patients died (probably from pyæmia), and within the labyrinth the products of inflammation were found after death. In the cases to which recently the term has been applied, the patients do not die, nor do they suffer in health, except, in so far as it may be said to be affected by the temporary symptom of giddiness. An adult man, or woman, is seized with giddiness, and perhaps some vomiting. Severe tinnitus draws attention to one ear, which is then found to have extensively lost its hearing. An examination proves the external and middle portions of the ear to be healthy. The symptom of giddiness recurs frequently. If the patient attempts to walk, his gait is very unsteady.

This inability to walk without support occasionally lasts for many days, and even sometimes for weeks. After a time, with the exception of deafness and tinnitus, the unpleasant symptoms cease. These cases have received of late years considerable attention from physicians, and the complete absence of any danger to life is fully recognised. For some days after the attack, the patient should be kept in a recumbent position, as any attempt to walk is apt to bring on a fit of giddiness. The late Mr. Hinton and Dr. Hughlings Jackson have both carefully studied the manifestations of symptoms in these cases. In truth, this is the only way in which they admit of study, for the pathological condition which induces them is by no means determined. The experiments of Flourens, which at one time were thought to have settled the functions of the semicircular canals in regard to the maintenance of equilibrium of the body, have since been controverted, so that it seems improbable that this portion of the labyrinth is the seat of the lesion. As a matter of experience, when the giddy attacks cease the hearing suffers no further loss. Considering the association of vomiting with the giddiness, also the fact that irritation of the tympanum will often cause the patient to vomit suddenly without any feeling of nausea, that irritation of the pneumogastric nerve causes unsteadiness of gait as well as nausea or vomiting, and that the auditory and pneumogastric nerves are intimately connected at their origin, it seems quite possible that the giddiness and sickness in these cases may be due to reflex action of the pneumogastric, excited by some lesion situate on the course of the auditory nerve, or to some disturbing cause at the point of origin of these nerves. Any explanation amounts to nothing more than conjecture. This observation is equally applicable to tinnitus, which occurs so frequently in all nervous affections of the ear. We know that any pressure on the labyrinth will excite it. A piece of cerumen in contact with the tympanic membrane, and so acting through the chain of ossicles on to the stapes, causes tinnitus. So, for the same reason, will any pressure within the tympanum; the removal of the cause in each case being instantly followed by cessation of the symptom. When, however, it is present without any discoverable change in the ear, it can be regarded as nothing more than a symptom, and a very constant one too, of disturbed function. If we consider for a moment that an overdose of quinine is enough to excite it, it is not to be wondered at that an absolute reason for its existence often cannot be given. There is perhaps no kind of noise to which tinnitus has not at some time been compared by those who have suffered from it, and in extreme cases it gives far more distress than the loss of hearing.

The hearing becomes affected in some young women at the birth of their children, and it may then generally be predicted that each successive confinement will be followed by a still further degree of deafness, which seems to be increased very much

if the children are nursed by the mother. In these cases there is also considerable tinnitus. Indeed this symptom, often so difficult of explanation, is almost always present when the perceptive power of hearing is at fault. Some people who suffer for years with tinnitus, which resists all treatment, suddenly lose it without any more assignable cause for its departure than for its advent. Perhaps in the instances referred to where the hearing in women becomes affected about the time of a confinement, the change is due to mental causes. It is certain that the emotions have a most remarkable and decided influence upon the hearing, and probably more than on any other special sense. I have frequently known the hearing to be suspended in a great measure for days at a time under the influence of some circumstances which caused great mental suffering. These cases are allied to, though not precisely like, those in which, as previously mentioned, the occurrence of the deafness was sudden and lasting. It seems reasonable to conjecture that, whatever may be the nature of the change, it is central, rather than situated within the labyrinth.

The much-vexed question of why a certain number of persons, in whom the hearing is defective, can hear better whilst loud sonorous vibrations are going on around them, has received at various times many explanations. Some of these, of the most ingenious and plausible character, are inconsistent with the fact that the peculiar symptom is undoubtedly present when the history and an examination of the ear prove that the middle ear is absolutely healthy. It is difficult, then, to accept any theory which presupposes morbid change within the tympanic cavity, or in the substance of the membrane. On the other hand, it is true that this phenomenon is often present where there has been long-standing catarrhal disease of the middle ear. Still, in practice, it is not unusual (indeed it is very common) to meet with cases in which there are two distinct elements—viz. disease of the conducting apparatus, and, superadded to this, symptoms of so markedly nervous a character that they are independent of the failure in the conducting apparatus. I prefer, therefore, to offer no decided opinion in explanation of the fact that some persons in whom there is tympanic disease, and some in whom there certainly is not, can hear better in a noise (such as being in a railway carriage, standing by a waterfall, or in a manufactory amid the sounds of looms and other machinery). That this increase in the capacity of hearing is real, and not imaginary, can be readily shown by tests with some constant sound. All observers are agreed that this symptom is an unfavourable one in regard to the recovery of the hearing at any time. Amongst the first signs of the loss of hearing, due to the degeneration which accompanies old age, is the inability to hear very high notes. The whistle designed by Mr. Francis Galton for testing the range of hearing in animals will demonstrate this. A similar inability to hear very high notes often accompanies obscure nervous affections of the auditory apparatus.

There are within my knowledge a certain number of families in which for several generations there has existed a predisposition to lose the hearing. In examining many of the subjects of this malady, I have been unable to detect any change in the conducting portion of the ear, or to elicit any history of catarrh. It seems fair, therefore, to infer that a tendency to lose hearing power may be inherited —at least, this is an impression which amounts to a conviction with me.

W. B. Dalby.

AFFECTIONS OF THE MUSCULAR SYSTEM.

ALTHOUGH muscles are so much exposed to accidents and violence, they are not readily injured; nor, considering their high organisation, are they frequently the seat of disease. Muscles may suffer from contusions, strains, rupture, and wounds of different kinds. Severe contusions are frequently followed by temporary loss of power in the muscle; this, together with the extreme pain in any attempt to move the part, particularly in the neighbourhood of the large joints, sometimes leads to the suspicion of more serious injuries, as fracture or dislocation. Strains of muscles are often followed, especially in later life, by pains of a lasting and troublesome character, partaking of the nature of rheumatism. Muscle may be ruptured either from external violence or from the too energetic action of its own fibres; this latter occurrence is by no means a common one, especially that in which the entire muscle is torn across. In the living body, muscle offers a greater resistance to a force tending to rend it than either tendon or bone; and when it does give way, it is for the most part at its point of junction with the tendon. Sédillot [1] says that in twenty-eight cases of rupture of muscles, thirteen were ruptured at this point.

The power of resistance in a sound and healthy muscle in a state of full tonicity is enormous; and many interesting comparisons and calculations on this subject will be found in Borelli, *De motu Animalium*. Percy [2] relates the case of a person with wry neck, who was suspended by the head, with a view of putting the muscle on the stretch; the result was separation of the muscle from its insertion, but no laceration of its fibres: and in a case in which the thumb was torn off, the tendons were drawn out, but the muscles were left uninjured, except at the point of junction with the tendon. We are all familiar with the fact that the tendon of the rectus femoris and the tendo Achillis give way rather than the fibres of their respective muscles. With the loss of its vital contractile power, muscle loses its advantage over tendon, and the experiments of Richerand and others fully establish the fact that after death muscle is more easily ruptured than tendon. We observe this when a limb is forcibly straightened from the bent position after the muscles have become unusually rigid from convulsions before death; here laceration of the muscles, and not of the tendons, takes place.

Though muscle in the living body is not often ruptured, yet cases of this injury occur sufficiently often to have given most of us one or more opportunities of witnessing it. Sédillot has recorded no less than twenty-eight cases of entire or partial spontaneous rupture of muscles; but he observes, that no voluntary act can occasion a rupture of their fibres, however powerful the effort may be, and this for two reasons: 1st, because, under the influence of the will, all the fibres of a muscle, and the muscles associated with it in its action, contract uniformly, simultaneously, and in a regular order, to overcome a resistance; and 2ndly, because at the moment that the will perceives that the power opposed to it is greater than its efforts can overcome, it ceases to strive further. Rupture, therefore, can only take place when, in some involuntary or instinctive effort, as in the endeavour to recover the equilibrium in a false step, or from some similar cause, the whole force is thrown in a violent and unexpected manner upon one or two muscles, or even on a few fibres. Among the cases collected by Sédillot, is one in which the rectus femoris was ruptured. In

[1] *Mém. sur la Rupture musculaire*; Mém. et Prix de la Soc. de Méd. de Paris, 1817, p. 115.
[2] *Journal général de Médecine*, vol. lxi.

another case, the psoas magnus muscle was found ruptured after death, the patient having died from inflammation and suppuration following the accident. The complete rupture of the biceps muscles of each thigh occurred in a man falling from a height; and the two recti abdominis were torn across at their upper part in a young man, in the struggle to save a tray of cement as he was falling from a platform.

Rupture of the adductors of the thigh may also occur in the effort of riders to recover their balance when their horse makes a sudden and unexpected start to one side. But perhaps one of the most frequent injuries of the kind is that of the extensor brevis of the foot, due to turning the ankle under, as it is called. Here the contracted ends of the torn muscle may be easily felt, as well as the collection of blood between them.

It more frequently happens that a few fibres only of a muscle are ruptured, and this usually occurs in the gastrocnemius.[1] Muscles are sometimes torn across in violent paroxysms of muscular spasm, as in tetanus or vomiting. In these cases the ends of the muscle, from the violence of the retraction, are thrown into considerable swellings.

In a case of acute traumatic tetanus, under Larrey, the man was immersed in cold baths, after each of which the convulsions and muscular contractions were most severe, and he died in three hours; a swelling, however, had been previously observed below the umbilicus, on the right side. On a post-mortem examination it was found that the tumour was occasioned by the retracted ends of the rectus, which was entirely torn across. The space between the two ends of the muscle was filled with blood. Mr. Curling describes a case in which portions of both recti abdominis were ruptured by tetanic convulsions (one of the specimens is in the Museum of the College of Surgeons). Mr. Gray exhibited, at the Pathological Society, the rectus muscle of a patient who had died of tetanus, in whom almost complete transverse laceration of the muscle had taken place. In Mr. Earle's case of tetanus, described in *Med. Chir. Trans.*, vol. vi., one of the psoas muscles was partially ruptured. Boyer relates the case of a strong man admitted into La Charité with 'bilious fever;' an emetic was given him, and whilst vomiting, acute pain was felt a little below the middle of the left rectus abdominis muscle. On examining the part, there was neither tumefaction nor discoloration of the skin, but an indentation, into which the fingers could be placed, was felt. The man died; and the muscle was found completely torn across, the two ends being an inch apart, and the space between filled with blood Another case of the same kind has recently been observed at the Middlesex Hospital.[2] And in the case of a young woman who died at University College Hospital during an attack of severe vomiting, and on whom I performed a post-mortem examination, the only lesion found to account for the sudden death was rupture of the œsophagus into the left pleura, just above the diaphragm. The specimen is preserved in University College Hospital Museum. Mr. C. Holthouse relates an interesting case of tear of the rectus abdominis in a man who, to save himself from falling, caught at part of a scaffolding, and hung suspended for a time until rescued, when the muscle was found to be torn. He had felt the giving way most distinctly.[3]

The rupture of a muscle is accompanied by extreme pain, resembling that occasioned by a smart blow from a whip or stick, and often by a distinct sound like the snapping of a cord; all motion of the part is either impossible, or is accompanied by such severe pain, with spasmodic twitching, as to cause the patient to desist. If the muscle be a superficial one, a deep indentation will be found at the seat of rupture, produced by the retraction of its divided ends; and often a considerable swelling, proportioned to the vigour of the contraction of the torn fibres, as in tetanus; and as there is always extravasation of blood, much discoloration of the skin will follow. The indentation and extravasation are not apparent, however, in ruptures of the deep muscles, by which their diagnosis is rendered less clear. If the rupture be discovered early, and judiciously treated, a sufficient approximation of the divided ends will result, good union will follow, and the function of the muscle will be restored. If, on the other hand, it be overlooked or maltreated, or if it occur in a part where proper measures cannot be employed to approximate the ends of the muscle, as in some parts of the trunk, in ruptures of the deep muscles about the hip and shoulder, &c., it will be found that a wide separation exists, and that the ends of the muscle, instead of uniting, have become attached to the parts in the immediate neighbourhood, and the use of the muscle is consequently lost.

[1] Wardrop, *Med. Chir. Trans*, vol. vii.

[2] *Lancet*, 1882, p. 687.

[3] *Path. Soc. Trans.* xiii. 263.

The treatment consists, 1st, in placing and retaining the part in the position most favourable for relaxing the muscles; and, 2nd, in approximating the separated ends to one another by even compression, which we know exercises so great a power in controlling and modifying the excess of contraction in the muscles, in fractures, &c. As regards the first, this is easily accomplished in the limbs: thus in rupture of the rectus femoris the knee is straightened, and the limb is raised to an angle with the body, as in fractured patella; but where the rupture occurs in the trunk, this cannot be done so readily; yet in a case already alluded to, in which both recti abdominis were ruptured, a good union was effected by keeping the patient in a sitting posture, the body being bowed forward, together with proper bandages.[1] The second is accomplished by an even and uniform compression of the muscles by means of carefully-applied flannel bandages, or laced belts, aided in some cases by a strip of leather or gutta-percha. In addition to these measures, bromide of potassium may be freely administered internally to aid in the relief of spasm. At the end of from a fortnight to three weeks, the union is generally completed. The process of union is similar to that of other structures; the effused blood is absorbed, plastic lymph is poured out, which assumes by degrees the firm and resisting character of tendon, muscular fibre itself being never reproduced. When a muscle, with the integument and parts around, is divided, it retracts to a greater extent than where the muscle alone gives way, from being deprived of its collateral support. This, in conjunction with an open wound, renders it extremely difficult to approximate the retracted ends of the muscle, and to find means for retaining them in a proper position; hence it will be found that wounds extending through muscles are followed by nearly complete loss of use in the latter, the great chasm between their ends being filled up by granulation. It is recommended to endeavour to bring the ends together by sutures with all antiseptic precautions both before and after the operation. These measures, with position favourable for the approximation of the ends, and such encircling supports as can be employed where a wound is present, may do much towards restoring the muscle to a certain amount of usefulness.

Inflammation of muscle.—Inflammation of muscle, or Myositis, may be primary or secondary, and may be due to a variety of causes, operating from without or from within, and may be met with in every degree, from slight congestion to free suppuration. Those causes which operate from without are blows, strains, or other forms of violence. Those operating from within are rheumatism; the various septic conditions of the blood coming under the head of septicæmia and pyæmia (*vide* Pyæmia, vol. i.) and also the vicinity of other inflamed parts.

Myositis from injury, unless the latter have exposed the tissue to the entrance of impurities, is usually of the plastic kind, and runs its whole course as a rule without suppuration. It commences as a simple hyperæmia of the vessels of the part, and may never advance further, usually subsiding before long. In more severe cases there is plastic exudation into the interstitial connective tissue, with proliferation of the corpuscles of the latter. It is still sometimes questioned whether the muscle corpuscles also participate in the plastic change, but it is almost proved that they do.[2] The plastic matter thus formed usually organises after a longer or shorter period (in healthy cases) into fibrous tissue, which takes the place of the original muscle fibres in the form of a white knot or band. If the process be more acute, the exudation and proliferation exceed the bounds of plastic change and produce pus. This makes its way to the surface if in large amount, and is discharged; if less abundant, it may be completely or partly absorbed, leaving a little caseous matter behind. In either case a scar of fibrous tissue remains at the seat of inflammation which is never replaced by muscle fibres. Occasionally a deposit of calcareous material takes place at the seat of old inflammation forming larger or smaller nodules.

Myositis due to causes operating from within is very frequently suppurative. This does not hold good of the rheumatic form, but with the various kinds of septic disease does so. Whatever be the irritant in rheumatism, it leads only to a chronic

[1] Richerand, *Nosograph. Chir.* vol. ii.
[2] Cornil et Ranvier, *Man. d'Hist. Path.* 2nd ed. p. 533.

hyperplasia, resulting in thickening of the connective tissue of the muscles, with consequent impairment of their functions. But in the septicæmic inflammations it is almost the rule for pus to form. This may collect in smaller or larger accumulations in any of the muscles of the body. In the deeper parts its existence may not be easily proved, but superficially there can be no difficulty in detecting the condition.

The local subjective and objective symptoms of abscess in muscles, whether caused by external or internal agencies, are generally much alike. There is local pain, much aggravated by any movement of the part, also heat and throbbing. The muscle is usually contracted to a considerable extent and rigid, feeling hard and firm to the finger. The part of the body in which this contraction takes place is correspondingly deformed more or less, often to an extreme degree if it be a limb; there will also be œdema around, and a blush in the skin in the case of superficial muscles.

The treatment of this condition in its earlier stages will consist in leeching in simple cases, followed by hot fomentations, and the application of belladonna extract mixed with glycerine, while the part is kept at complete rest. Later when pus is manifestly increasing, a free evacuation of the abscess by aspiration or incision under the strictest precautions as to cleanliness will be called for.

After such an abscess has healed, the muscle is frequently left in a contracted condition, which will require both passive and active exercise for its removal. The inflammatory material spread through the parts around will be gradually absorbed, and probably nothing but a small contracted fibrous scar remain.

In that form of myositis due to sepsis the internal use of quinine in free doses, or of the salicylates, with abundance of stimulants, is called for.

Tertiary syphilitic change, having many features in common with inflammation, will be last considered here. One of the first in this country to describe its effect on muscle was Mr. Tatum, in a paper read before the Royal Medical and Chirurgical Society, in January, 1845,[1] in which a group of three cases, two of which were associated with other symptoms of constitutional syphilis, was described, whilst the history of the third case was obscure. The disease, which he had not seen alluded to before, appeared in the form of rounded enlargements in the left sterno-cleido-mastoid muscle; there were three swellings in two of the cases, and two only in the other; in one of these there was also an enlargement in the tendinous origin of the part; the tumours were evidently formed in the substance of the muscles, and were nearly of the size of a pigeon's egg, and gave the latter a singular beaded appearance; there was stiffness, with much tenderness, in the part, and great pain when the muscle was in action; the skin was neither adherent nor discoloured; the disease was slow in its progress, and had remained nearly stationary for some months. All the cases occurred in females, probably from the neck being more exposed than in men, in each case the effects of the iodide of potassium were manifest. In the first case the patient obstinately refused to take the drug, in consequence of which mercury and various other remedies were tried without any good effect. After some time she consented to take the iodide of potassium; from two to three grains were administered thrice daily, while the iodine ointment was applied externally; the tumours soon began to diminish, and in less than six weeks completely disappeared. The other two cases were similarly treated, with complete success; but in one of them the patient was obliged to lay aside the remedy for a time, during which it was remarked that the tumours became stationary; on her resuming the medicine, however, all remains of the disease quickly left her. What constituted the swellings could not of course be ascertained from these cases; but a case occurred some time after, in which there was a tumour in the middle of the biceps muscle, so hard and defined as to induce the surgeon to proceed to its removal by operation, when, on cutting into the fibres of the muscle, no tumour was visible, but the muscle in that part was congested and infiltrated with a greyish kind of lymph, great part of which oozed away with much blood, all the swelling subsided, and the wound healed, leaving no enlargement. Much light has been thrown upon the nature of the gummatous deposits of late, and their ubiquity has been fully demonstrated. It is unnecessary,

[1] *Lancet*, vol. i. 1845, p. 136.

therefore, to describe their structure in muscle specially, further than to say that they infiltrate this tissue as elsewhere, and undergo the same secondary changes. Thus they may be rapidly absorbed under treatment, leaving no trace behind of shrinking or induration: they may undergo fibrous, fatty, or calcareous degeneration, or, approaching the surface, may thin and break the skin, and then undergo softening and liquefaction, leading to deep ulceration and loss of tissue. I have this day treated a case in which, together with a breaking-down gumma over the sternal insertion of the sterno-mastoid muscle, there was a second well-defined gummatous mass in the body of the muscle higher up, which gave no trouble and showed no signs of inflammation.—[A. E. B.]

Sometimes there is a *simple contraction*, or shortening of a muscle, without apparent alteration in its structure or change from its normal condition, as an occasional effect of the presence of syphilitic poison in the system, and is usually found in the muscles of the arm or fore-arm. M. Ricord has noticed this so long ago as 1842.[1]

M. Notta, in an interesting paper on Syphilitic Muscular Contractions,[2] gives three cases, the features of which were much the same; and in each the biceps was the seat of the contraction. There was no hardness or rigidity of the muscle when not in action; the pains were variable, being great on putting the muscle on the stretch, and mostly referred to its insertion. The contraction was slow, and gradually reached a certain point, causing fixed flexion of the elbow. The iodide of potassium, with minute doses of the proto-iodide, appears to have cured every case. The same may be said of the cases cited by Ricord[3] and others, in which there was a certain change of structure of the muscle, associated with contraction. As a general rule, mercury has done no good; in fact, in many of the cases the disease appeared to increase while the patient was undergoing a course of the drug.

Muscular atrophy.—Muscular tissue is frequently subject to atrophy, which may consist of one or more of the following alterations:

1. Simple atrophy.
2. Atrophy with granular degeneration.
3. Atrophy with fatty degeneration.
4. Atrophy with (the so-called) waxy degeneration.

In *simple* atrophy the degree of wasting of the muscular tissue varies considerably. Generally, the fibres, although paler and reduced in diameter, retain their anatomical characters. The transverse and longitudinal striæ are well marked, the sarcolemma preserves its usual delicate and transparent appearance, and the nuclei it contains are not increased in number. Such is the form of atrophy met with in chronic and exhausting diseases; in cerebral paralysis; after contusions, compressions, and affections of the joints. In many diseases, however, both acute and chronic, simple atrophy, or wasting of the muscular fibres, is accompanied, in a greater or less degree, by one or more of the degenerations above mentioned. Such is sometimes the case after acute fevers, particularly typhus or typhoid; after alcoholism, lead-poisoning, rheumatism, &c.

But there is another form of this malady, which is known by the name of *progressive muscular atrophy* (Cruveilhier), *atrophie musculaire graisseuse progressive* (Duchenne), and *wasting palsy*. This curious disease differs in several respects from the atrophies above mentioned. It is always chronic, but of uncertain duration; is frequently hereditary; is capricious or irregular in its invasion; prone to spread from one part to another, or become general, and thus go on to a fatal termination. The affected muscles suffer different degrees of wasting, and assume a variety of aspects. Even in the same muscle, bundles in different stages of atrophy and degeneration may be found at the side of others that have retained their normal state. When the wasting is extreme in all the bundles, a long muscle may be reduced to a mere fibrous and cylindrical cord, or to a kind of tendon, and a flat muscle may be reduced in the same manner to a kind of membrane. In some instances the atrophy may be *simple*—that is, the muscular tissue may be wasted

[1] *Gaz. des Hôpitaux*, p. 98. [2] *Archives générales de Médecine*, 4e sér., vol. xxiv. p. 413.
[3] *Gaz. des Hôpitaux*, 1846, p. 1.

to a considerable degree without any granular or fatty degeneration; but, generally, one or both of these alterations of structure is found to exist to a greater or less extent. The muscle also changes and varies in colour according to the nature and degree of the atrophy. It is paler than natural; occasionally it is quite colourless, like the flesh of fish; or it may have a faint yellow or ochreous tint. Its consistence for the most part is increased in consequence of the increase of the interfibrillar connective tissue. When examined under the microscope, the affected muscles may be seen to have lost to a variable extent and degree, or even entirely, the appearance of transverse and longitudinal striation, while in a corresponding proportion the sarcous or muscular element is transformed into granules, which, in some instances, are too fine to be distinguished as separate particles. The granules are soluble in acetic acid.

Granular degeneration or disintegration of the muscular tissue may exist alone; but frequently it is accompanied by fatty degeneration, or may only form the first stage of the latter change.

Fatty degeneration.—This morbid process may make its appearance in the muscular tissue at once; or, may follow, accompany, and altogether replace the granular change. Besides this transformation into fatty *particles*, fat-cells in unusual, and sometimes in great numbers, are found between the fibres, either collected into groups, or disposed in linear succession, like rows of pearls. These cells may multiply in proportion as the muscular tissue disappears, so that, when the fibres are reduced to mere filaments, there may be no loss of volume in the limb. An interesting case of this description is related by Mr. Hallett.[1] The degenerations seemed constantly to have commenced on the surfaces of the muscles, and extended inwards to their centres; so that many which appeared wholly converted into fat, exhibited, in their interior, muscular fibres in a more or less healthy condition.

Waxy or vitreous degeneration.—This structural change was first described by Zenker.[2] It is called by the French pathologists, *vitreous* degeneration.[3] According to Zenker, it is observable only in the voluntary muscles, and never attacks all the bundles of the same muscle. The essential change of structure consists of a transformation of the muscular tissue into a homogeneous, colourless, and glistening substance, in which the transverse and longitudinal striæ, together with the nuclei, have entirely disappeared. This kind of degeneration is more common after acute diseases, particularly after typhus and typhoid fevers, but occurs also in *progressive muscular atrophy*. Indeed, in this peculiar malady, all the three kinds of degeneration—the *granular*, the *fatty*, and the *vitreous*—may be seen, not only in the same patient, but in the same muscle.[4]

In a large majority of instances, *progressive muscular atrophy* first makes its appearance in one of the upper extremities, especially in the right limb. It begins commonly in the muscles of the hand, first in the thenar eminence, then in the hypothenar, and next in the interrossei. When the interosseous muscles are considerably wasted, the hand assumes the appearance of a bird's claw—the *main en griffe*, as it has been termed by Duchenne. If the atrophy extends upwards, the flexors and extensors of the fingers, and sometimes the muscles at the back of the forearm, become involved. When the disease extends beyond these limits, it attacks the muscles of the arms and trunk; the biceps first, then the deltoid and the triceps, the pectorals, the latissimi dorsi, the rhomboidei, the extensors and flexors of the head, the sacro-lumbales, the abdominal muscles, the muscles of respiration and deglutition. Occasionally the depressor muscles of the jaw become involved. In some instances the atrophy is limited to the muscles of the forearm, and in others it begins in the muscles about the thorax, and makes considerable progress, while the arms remain unaffected. Sometimes it extends to the lower extremities, but rarely begins there.

[1] *Edinb. Med. and Surg. Journal*, April, 1849.

[2] *Ueber die Veränderungen der willkürlichen Muskeln in Typhus abdominalis*, Leipzig, 4to. 1864.

[3] Cornil et Ranvier, *Histologie pathologique*, 2nd ed. 1881, p. 526.

[4] Charcot et Joffroy, *Archives de Physiologie normale et pathologique*, 1869,No. 3, p. 363

The unequal and irregular wasting of the muscles produces in the trunk and limbs a variety of alterations in their shape and position, which are characteristic of the disease; for in ordinary atrophy succeeding exhausting diseases, the emaciation is uniform, as it affects nearly all the muscles of the part to the same extent.

The earliest symptom of progressive muscular atrophy is a loss of muscular power in the afflicted parts, especially after exercise or exposure to cold. With this weakness there is an awkwardness in the patient's movements, and a certain loss of muscular co-ordination, arising from the unequal or irregular wasting of the muscles, and the consequent change in their relative force or antagonism when employed in the performance of voluntary movements. Among the other early symptoms are cramps, twitches, and fibrillary tremors in the muscles. Generally the sensibility remains unimpaired, but occasionally there is numbness of the skin, or a certain degree of cutaneous anæsthesia; while, on the other hand, in about half the cases, more or less pain is experienced in the wasting muscles, or previous to their atrophy. Occasionally there is a general rise of temperature, especially in the earlier stages of the disease.[1]

Pathology.—Cruveilhier, who was the first to investigate the morbid anatomy of progressive muscular atrophy, believed that atrophy of the motor nerves was the starting-point of the disease. This opinion was founded on eleven cases in which the motor nerve-roots were more or less wasted. But in the majority of instances in which post-mortem examinations were made, no appreciable alteration of the nerve-roots was discovered. It was therefore inferred that atrophy of the nerves cannot be the actual cause of that state of the muscles; and since no disease of the nervous centres had hitherto been detected, it was further inferred and generally believed that progressive muscular atrophy is a disease originating in the muscles themselves, in consequence of impaired nutrition, resulting from a peculiar diathesis of an hereditary tendency. The more recent supporters of this view were Trousseau, Duchenne, Meryon, Roberts, Oppenheimer, Friedberg, Hasse, Friedreich, Cohn, and others. But in 1861 Dr. Lockhart Clarke discovered in the spinal cord removed from a well-marked case of progressive muscular atrophy, numerous lesions of the grey substance, consisting chiefly of areas of what he called granular and fluid disintegration.[2] In several other cases which he subsequently examined, the same kind of lesions were observed in company with similar alterations of some of the white columns, with dilatation of blood-vessels, or atrophy of the nerve-cells and of the anterior roots of the nerves.[3] Since his first publication on the subject, several German and French pathologists, by means of improved methods of observation, have obtained similar results.[4]

The local changes in the muscles may be briefly described as consisting in 'chronic myositis, interstitial proliferation of connective tissue with secondary destruction of the muscular fibres, and finally fibrous degeneration.' The disease consists then in an essentially inflammatory process, a '*polymyositis chronica progressiva*.'[5]

Ætiology.—Among the predisposing causes of progressive muscular atrophy, consanguinity, or hereditary influence, is universally acknowledged to hold the first rank. Dr. Roberts collected the history of ten families in which muscular atrophy prevailed, and of these, twenty-nine individuals were attacked. Aran relates that a sea-captain had lost two maternal uncles and a sister by this disease, and that another patient's two aunts had died from the same malady. Meryon's first cases were four boys who had six healthy sisters.[6] In another family two boys were affected while

[1] Eulenburg, *Ziemssen's Cycl.* xiv. p. 108.

[2] Beale's *Archives of Medicine*, 1861.

[3] *British and Foreign Med.-Chir. Rev.*, July 1862, and Oct. 1863. Beale's *Arch. Med.* No. 13; *Med.-Chir. Trans.* 1866 and 1867.

[4] Lockhart Clarke. Beale's *Archiv. of Med.*, 1861, and *ibid.* No. 13, also *Brit. and For. Med.-Chir. Rev.*, 1862–1863; also *Med.-Chir. Trans.*, 1866–67. See especially Hayem, *Archives de Physiol. normale et pathologique*, Nos. 2 and 3, 1869. Charcot et Joffroy, *ibid.* 1869.

[5] Eulenburg, *l.c.* pp. 108 and 133.

[6] These interesting cases, with the microscopic appearances of the muscles, are recorded in vol. xxxvi. of the *Med.-Chir. Trans.*

the two sisters escaped. The male sex is therefore much more prone to muscular atrophy than the female—in the proportion of about six to one. In nearly all the hereditary cases on record, the disease became generalised, and therefore tended to a fatal termination.

Among the chief exciting causes are excessive muscular exertion, cold and damp —especially when combined—and injuries or diseases of the spine. In those cases which are attributable to the influence of cold and wet, the atrophy is generally preceded and accompanied by neuralgia or so-called rheumatic pains in the affected muscles, or in the course of the nerves leading to them. Syphilis, again, appears to be one of the assignable causes of the disease. To this form M. Rodet has given the name of *atrophie musculaire progressive syphilitique.*[1] In some instances no particular cause can be clearly assigned, and these are the cases in which hereditary influence appears to come into operation.

Treatment.—This must of course depend, to a certain extent, on the causes to which the disorder may be reasonably traced. Removal from the influence of cold and damp, or avoidance of undue muscular exertion, is of primary importance. Warm and sulphur baths, especially those of Aix-la-Chapelle, have been particularly recommended. When there appears good ground for believing that the atrophy is attributable to syphilitic taint, iodide of potassium, or perhaps mercury, must be employed. In cases attributable to other causes, vegetable and mineral tonics, cod-liver oil, and phosphorus may be administered. Dr. Meryon speaks very highly of the long-continued use of arsenic. But of all remedies hitherto employed, galvanism is undoubtedly the most useful, when applied to the affected muscles. Regular gymnastic exercises are also recommended by those who have had most experience of the disease. The benefit derived from it, however, is very often temporary. Remak strongly recommends the application of the constant galvanic current to the spinal column, particularly in the cervical region. The fact, as already stated, that in the advanced stages of progressive muscular atrophy, various lesions have been found in the spinal cord, would suggest the propriety of trying the effects of counter-irritants, particularly setons and blisters to the spine, in the early stages of the disease.

There are two other special forms of muscular atrophy, which are peculiar to the period of childhood, viz., the atrophy which follows infantile paralysis, and the degeneration of muscles with apparent hypertrophy or pseudo-hypertrophic paralysis.

1. The muscular atrophy of infantile paralysis is extremely interesting to the surgeon, in consequence of the deformities which it so frequently occasions. The period of childhood at which this disease makes its appearance varies from a few months to a few years after birth, more especially during the first dentition. The attack is generally sudden, and frequently preceded by a feverish state which may last a few hours or a few days, accompanied occasionally by convulsions, which are immediately followed by paralysis without loss of sensibility. The paralysis generally begins in the lower extremities, but rarely attacks the upper extremities alone. At first it is more or less general, but after a variable period it restricts itself to particular muscles, or groups of muscles, or to a particular member, and thus becomes localized. The muscles upon which it most frequently fixes are those at the anterior part of the leg—the extensors of the toes, and flexors of the foot; the extensors and supinators of the hand; the extensors of the leg, and muscles of the foot. Sometimes single muscles are affected, and most commonly, the extensor longus digitorum of the foot, the tibialis anticus, the deltoid, or the sterno-mastoid. Occasionally, but rarely, it is observed to affect the serratus magnus, producing a remarkable deformity of the scapular borders. After a time, varying generally from one to two months, but sometimes much longer, the paralysed muscles begin to waste, and may ultimately be reduced to mere fibrous bands. Laborde relates a case in which considerable atrophy of the deltoid muscle occurred in four *days* after the first appearance of the paralysis.[2] Nor is the atrophy confined to the muscles; it involves

[1] *L'Union médicale*, No. 26, p. 403, 1859.
[2] *De la Paralysie* (*dite essentielle*) *de l'Enfance*, p. 45.

the bones, ligaments, and other parts. Together with these grosser changes are associated others more minute in the spinal cord. These consist in sclerosis of the anterior cornua of its grey matter. This change, according to Charcot, is due to an inflammation affecting isolated groups of ganglionic cells, others around being unaffected. Some of these groups may recover, while many are destroyed, explaining the partial recoveries familiar to us.[1]

The paralysis and the atrophies by which this disease is succeeded combine to produce a variety of deformities and unnatural attitudes which call for the surgeon's skill, either in the application of mechanical apparatus, or in the performance of necessary operations. These deformities consist chiefly of *talipes equinus*, *equino-varus*, *equino-valgus*, *calcaneus*, or *calcaneo-valgus*, and *talipes varus* (*vide* Orthopædic Surgery).

The paralysis itself and the muscular atrophy to which it gives rise are not often fatal. The difficulty in treatment consists in restoring the muscles to their normal condition; but this, in many instances, may be accomplished. The remedies recommended by the most experienced practitioners consist of nux vomica, strychnine, cod-liver oil, the preparations of bark and iron; sulphur and salt-water baths; blisters and counter-irritants along the spine; stimulating embrocations to the affected muscles, and especially the application of electricity.

2. *Degeneration of muscles with apparent hypertrophy.*—This peculiar disease was first understood and diagnosed by Dr. Duchenne (of Boulogne) in 1858. Since then it has been recognised and investigated chiefly in Germany by Griesinger, Eulenburg,[2] Cohnheim, Berind, Wernich, Oppolzer, Heller, and Seidel. It begins in childhood, like the malady just described, but often continues up to an advanced period of youth, when the patient is cut off by some intercurrent disease. Its course may be divided into three stages; one of partial and incomplete paralysis; one of apparent muscular hypertrophy; and, lastly, one in which the paralysis becomes general, and the muscles waste. Eulenburg states that of 86 there were 70 males and 16 females=9:2. Again, out of 80 cases clearly recorded, it began before the fifth year in 45; between the sixth and tenth year in 22; between the eleventh and sixteenth 8 times. Only 5 times was it observed to commence in later life, viz., in men and women at the ages of 26, 30, 40, 41, and 43 years.

The first stage begins with weakness of the lower extremities, either before or after the period at which the child should be able to walk. In the former case, when the little patient attains the age of ten or twelve months, and attempts to move about or stand, it falls immediately, and continues unable to walk, even when assisted, for two or three years.

The second stage begins some months—or even as long as two years—after the muscular weakness, and is manifested by a progressive enlargement of the gastrocnemii, then of the glutei and lumbar muscles. This enlargement occurs sometimes in nearly all the muscles, but in general it is limited to a few. The enlarged muscles are firm and elastic, and become very hard during contraction. This condition may remain stationary for some years.

In the third stage the paralysis gradually increases and becomes more general. The patient is no longer able to stand upright; the upper extremities become affected; the enlarged muscles rapidly decrease in volume; and the limbs and trunk become atrophied *en masse*. In this state the patient may exist for a considerable time, but ultimately dies by intercurrent disease. Many of the children afflicted with this singular disorder have dull intellects, and are occasionally more or less idiotic.

The morbid anatomy of this disease has been investigated chiefly by Duchenne in France, by Eulenburg, Cohnheim, Griesinger, and others in Germany, and recently by Gowers in England, who has published a most complete essay on the

[1] Wilks and Moxon, *Path. Anat.* p. 251.
[2] Ziemssen's *Cyclop.* vol. xiv. p 10.

subject.[1] Nothing abnormal has been discovered in either the nervous or vascular systems. Eulenburg and Cohnheim found the electro-muscular contractibility everywhere perfect. To the touch the muscles gave the sensation of a doughy and inelastic mass. They were marked with stripes of a yellow or yellowish-white appearance. At certain points they could not be distinguished by the naked eye from the subcutaneous adipose tissue. There was also great hypertrophy of connective tissue between the muscular fibres, which were frequently much reduced in diameter, although they were not otherwise much altered. Duchenne and Ordoñez found the striæ on the fibres very much finer than usual, and semi-transparent. The same appearance, together with an increase of connective tissue, and large collections of fat-cells, were also observed in one case by L. Clarke. The disease is regarded by some as closely related to progressive muscular atrophy, *i.e.* as only a modification of the latter. (Eulenburg *l. c.*)

Treatment.—During its first stage the disease is sometimes curable. Duchenne has recorded two such cases.[2] But in the second stage scarcely any hopes of recovery can be entertained. The treatment consists chiefly of local Faradization and shampooing.

Ossification of muscle is occasionally met with, leading to the most remarkable deformity. The deposit is composed of true bone with cancelli, compact shell, periosteum, and cartilage, displaying also under the microscope all the signs of true bone. Ossific growths may take place over a large extent of the voluntary muscles, or may be limited to one or two points. In the Museum of the College of Surgeons is the skeleton of a man in whom nearly all the muscles of the back had become ossified, masses of bone occupying the places of the latissimus dorsi, spinalis, and rhomboid muscles, forming large bony sheets on the back and sides, while large stalactical growths spring from the pelvis, ribs, and scapulæ. The following case is valuable from the circumstance of its progress having been watched from its commencement up to its very advanced stage in 1862, when the account was published.

G. Brown, aged twenty-two, was originally admitted into St. George's Hospital under the care of Mr. Cæsar Hawkins in August 1843[3] with swellings in the dorsal and lumbar regions, some of them apparently bony. Their appearance was accompanied with severe rheumatic pains. All these disappeared under treatment. They reappeared, however, and then one was removed from between the trapezius and rhomboid muscles; it was intimately connected to both, fibres from each being inserted into it; one end of it was fixed to the spines of the sixth and seventh dorsal vertebræ, the other was smooth, playing on the end of the scapula. After this, for four years, fresh tumours were observed to form in different muscles of the trunk and neck, being at first soft, growing rapidly, then becoming hard, and, after a time, either disappearing altogether under treatment, or leaving a bony deposit behind. This new bone extended slowly towards either extremity of the muscle in ridges corresponding to its fibres. He was now lost sight of, but in June 1859 again presented himself at St. George's Hospital, with extensive ossification of the muscles, together with several exostoses both on the spine and ribs. The greater part of the latissimus dorsi on either side, especially at the free edges, was ossified; large masses of bone filled up the hollows on either side of the vertebral spines from the sacrum to the occiput, soldering all the bones together into an inflexible column. The ribs were likewise immovable, partly from being anchylosed to the spine, and partly by the ossification of the muscles connecting them with the scapula and spine; so that respiration was entirely performed by the diaphragm. The trapezius, and, apparently, the deep muscles at the side of the neck, contained large deposits of bone; both scapulæ were immovably fixed to the ribs, principally by the ossification of the serratus magnus and rhomboid muscles. In front, both the great pectoral muscles, from their origins to their insertions, were almost entirely ossified, presenting ridges taking the course of the fibres, and forming large masses at the folds of the axilla. The sterno-hyoid and sterno-thyroid muscles were much ossified; and these, together with the recent appearance of a considerable swelling below the chin, had been accompanied with so much difficulty in deglutition as to alarm him; he therefore came to the hospital to see Mr. Cæsar Hawkins, under whose care he had before been. The fulness in the upper part of the throat was not hard, but very tender; it yielded to a second application of a blister in a few weeks, so that the genio- and mylo-hyoid muscles could be distinctly felt almost entirely ossified. Preparations from this case are in the Museum of St. George's Hospital.

The cause of this osseous growth in muscles is not always easily explained. A tendency to increased bony deposit is not very uncommon, and shows itself in

[1] *Pseudo-Hypertrophic Muscular Paralysis.* (Churchill, London, 1879.)

[2] *De la Paralysie musculaire pseudo-hypertrophique,* Paris, 1868; and *Archives gén. de Méd.* Janvier et seq. 1868.

[3] *Med. Gaz.* vol. xxxiv. 1844, p. 273.

exostosis and extension of bony growth into the tendons inserted into the bones; but in ossific growth in muscle it is a distinct formation, and in no way, at first, connected with exostosis. That it is of inflammatory origin, the pain and swelling, and also the effects of remedies, would appear however to indicate clinically, as well as the observation of Munchmeyer (*vide* Rindfleisch [1]), who showed clearly that we have here to do with an actual ossification of interstitial exudation, or 'Myositis ossificans multiplex progressiva.' The disease is also in many cases evidently directly due to chronic irritation from recurring injury, acting on those with a peculiar predisposition. Thus it was common among the Prussian soldiers of former days when a drill regulation required the musket to be brought up against the deltoid repeatedly with a sharp rap. The consequence of this was in many cases the formation of what was known as the 'drill bone.' This consisted of a somewhat triangular plate of bone, springing from the insertion of the deltoid and running upwards in the muscle for from three to five inches. It was usually one to two inches broad, and had a circumference of four to five inches. Abernethy [2] also mentions the case of a lad in whom an exostosis or bony growth in a muscle invariably followed a blow on the part. Again, myositis ossificans is sometimes met with at the origin of the adductor muscles of the thigh, starting from the pubic or ischial ramus as a consequence of the irritation and pressure on the part in those who ride much.

As regards the treatment, no local measures answered in the above case so well as blisters, under which, with the exhibition of colchicum internally, considerable diminution of the swellings and relief of the pain took place. The swellings completely disappeared after a course of the iodide of potassium, at first five, and then seven, grains thrice a day in sarsaparilla; but they returned again shortly after, while the patient was still taking the medicine. On the reappearance of the disease, mercury was given, two grains of calomel and a quarter of a grain of opium twice daily, which at the end of three weeks produced sore mouth; again, all the swellings were nearly removed, at first rapidly, then slowly; but a large mass of bone between the scapula and spine was removed, as stated, by operation. After this, from hæmorrhage and other causes, his health failed, and he was much reduced, and specifics were laid aside for some time. Numerous fresh tumours having, however, formed, he, in a few months, began the phosphoric acid, first in half-drachm, and afterwards in drachm, doses, three times daily, which he continued from April 6 to May 21. The swellings greatly diminished under this treatment, and with the repeated application of blisters their recurrence seems to have been arrested. Thus the remedies appear to have been chosen with a view to the inflammatory nature of the complaint, and to have been most efficacious; yet so strong was the tendency to relapse, that the swellings formed again and again, even under the treatment that had caused them to disappear. They were, however, finally arrested, the blisters having been most conducive to that end.

Tumours in Muscles.

Tumours of various kinds are often found in muscles either as primary or secondary growths. The primary new growths here are, however, few. They consist in the fibromata, enchondromata, or fibro-enchondromata, the myxomata, or lipomata. Most usually the new growths occur in muscle proper as extensions from neighbouring parts, or as secondary deposits. Primary sarcomata are rare here. When neoplasms are present, they are developed from the young connective tissue between the muscular bundles. In their growth they lead to degeneration of the latter by pressure which may be simple, or granular, or fatty.

Primary carcinoma of muscles is unknown, but secondary deposits from both scirrhus and encephaloid are frequent. The same effect is produced upon the muscle bundles here as above.

Epithelioma is only found in muscles as an extension from neighbouring mucous membranes. It presents no peculiar characters here.

[1] *Path. Histology* (American translation), p. 676.
[2] *Surg. Lect.* iii. 169; *Lancet*, April 1825.

Gummata have already been described as occurring here, and tubercular deposits are likewise found (*vide* DISEASES OF TONGUE).

Vascular tumours or angiomata are not infrequent in muscles. Here they occupy the interstitial connective tissue, and may attain some size. They must not be confounded with varices. Extravasations of blood occurring from injury or in the course of an attack of scurvy may also give rise to fibrinous knots in muscle which must not be mistaken for new growths.

Cysts of various kinds are occasionally found in muscles. Some of these cysts contain hydatids. Such is the *trichina* spiralis, a bisexual and minute nematode worm which is reproduced viviparously by the female parent. The female trichina is about one-third longer than the male, and in the mature state contains in its uterus a variable number of ova, as well as free embryos in different stages of development. When the flesh of an animal containing spiral trichinæ is eaten by another, the contents of the small intestines are found, after about twenty-four hours, to contain a multitude of these worms, which lie imbedded in the mucus or in the chyme. Soon after the embryos are born, they begin to migrate from the intestines in search of muscular tissue, upon which they feed and develop. Concerning the manner in which migration is effected, there is some difference of opinion. Most observers believe that the young trichinæ pierce the walls of the intestines and other parts until they reach the muscles; while other observers, with Dr. Thudichum,[1] contend that, after penetrating the mucous membrane of the intestines, they enter the blood-vessels and lymphatics, pierce the lymphatic glands, reach the heart with the venous blood, traverse the lungs, and are then distributed, by the arterial circulation, to all parts of the body. However, having reached the muscles, there they feed, and grow, and ultimately become encapsuled. Leuckart maintains that the young trichina always penetrates the sarcolemma, while other observers assert that it lives and grows either inside or outside that sheath. However this may be, so long as the worm remains outside, the muscular fibre is not permanently damaged, although it becomes somewhat granular, and loses the distinctness of its transverse striation. But if the parasite pierces the sarcolemma, the fibre is permanently destroyed; the sarcous elements are disarranged, broken up, and transformed into granular masses, which constitute the food of the invader. As the trichina reaches its full growth and becomes fixed to one spot, the interstitial connective tissue and the sarcolemma around it, being irritated and inflamed, throw out an exudation, while the nuclei of both enlarge, divide, and rapidly multiply. The exudation, which appears to consist of fluid fibrine, soon after solidifies and forms a capsule in which the worm coils itself up. At the end of some weeks after infection, fine dark granules of carbonate of lime and magnesia are deposited in variable numbers within the capsule, and render it more or less opaque.

In man, trichiniasis is produced by the ingestion of imperfectly-cooked flesh of animals infested with trichinæ—particularly pigs.

The pathognomonic symptoms of trichiniasis are the following:—

Sudden swelling of the face, particularly the eyelids, after the patient has for some days felt prostrate and lost his appetite; fever, with quick pulse and copious perspirations, which have sometimes an offensive odour; painfulness and immobility of arms and legs; the muscles are swollen and contracted, and give great pain when set in motion or touched; the limbs are semiflexed; gastro-intestinal catarrh, with red and somewhat dry tongue; when the swelling of the face has subsided, the feet, legs, and thighs become œdematous, and soon after anarsarca over the trunk ensues. There is no other disease in which this particular combination of symptoms occurs.

Cysts containing a black tenacious matter are occasionally found in muscles; they probably are of the nature of hæmatoma occurring in other parts of the body, being merely unabsorbed extravasated blood, which has become darkened and inspissated by time. Warren describes a singular tumour somewhat of this nature. This was about the size of an egg, and was removed from the substance of the rectus

[1] See Thudichum, *Seventh Report of the Medical Officer of the Privy Council*, 1864. Also Althaus, *Med. Times and Gaz.*, 1864.

femoris muscle of a woman; it was said to be of only five or six months' growth; it consisted of a hard dark-coloured muscular substance, in the centre of which was a bony shell an inch in diameter, containing a dark-coloured fluid, which had deposited a black crust on the bony cysts.

Affections of Tendons, their Sheaths and Bursæ.

Injuries of tendons.—It has been already observed that tendons are ruptured by the action of their muscles more readily than the muscles themselves; they may also be torn by direct force, as in dislocation, and they are often divided partially or entirely in wounds, and by subcutaneous sections. When a tendon is ruptured, or, what is nearly the same thing, divided by subcutaneous operation, the part which is attached to the muscle is drawn away from the opposite end for about an inch; this latter is but slightly retracted by the action of its antagonists. Blood is poured out between the ends, but much less than in rupture of muscles. The pain is said to be not very great; a considerable shock, however, is felt, as from a blow received on the part, accompanied by cramp of the muscle, and a perfect inability to use the limb; and in rupture of the tendo Achillis a feeling is described as if the heel were sinking into a hole in the floor. The tendons most frequently ruptured are the tendo Achillis, and the tendons of the rectus femoris, and the triceps humeri. If the separation of the ends be not too great either in rupture or subcutaneous division, they unite with much readiness, the new material soon acquiring great firmness. So rapidly is the process of repair carried on, especially in the early stage, that, according to Mr. Paget, in his sixth lecture at the College of Surgeons, a specimen six days after division (being the fourth occupied in the organism of the new structure) could bear the weight of twenty-five pounds; in another case the new material at the end of twenty-one days bore a weight of fifty-six pounds. The process of repair is briefly this. For the first forty-eight hours plastic matter is poured out, the tissues around the divided ends encasing the latter and the effused blood. In five or six days, this material can be seen to be nucleated, and to be assuming a definite cord-like form. The cut ends of the tendon swell at the same time, become softened and vascular, until their tissue comes to resemble the plastic matter lying between them. The vessels of both now intercommunicate, and they are thus thoroughly fused into one. The plastic matter now becomes filamentous, its cells lengthening out into threads, thus using up all their protoplasm and leaving only the nuclei behind. Then the vascularity decreases in both the new material and in the softened ends of the tendon; both become firmer, until about the tenth day they are pale and firm. In about three weeks the process is completed, and a strong cord of fibrous tissue is formed, in all points a complete tendon. Should the interval between the two ends of a divided tendon be great, a very imperfect bond of union will be established between them, as the end will become attached to the neighbouring tissues, and either a partial or entire loss of the use of the muscle will result. Where the integuments and surrounding parts are included in a division of a tendon, there is, as in muscle, a much greater retraction than where these parts remain entire; added to which, the material for the repair of the tendon being here common to all the other tissues included in the wound, they all become fused into a common cicatrix, so that under the most favourable circumstances a very imperfect cord and limited use of the muscle remain.

The treatment of ruptured tendon consists, as in rupture of muscle, in approximating the divided ends as far as possible, and retaining them in that position until firm union is established. Close adaptation cannot be hoped for in all cases, but still a perfect union with recovery of the action of the muscle usually takes place. Whenever practicable, an attempt should be made to defend the wound from the contact of all impurities, and to render it aseptic if an open one. If this can be done, the divided ends of the tendon may be brought together with sutures, and a better result obtained than otherwise, unless suppuration subsequently take place. The severed ends are also brought closer and closer towards one another by the contraction of the

material as it becomes perfected, and the remaining deficiency is fully compensated for by the accommodating nature of the muscle. If the tendon of the triceps be torn, all that is required is a bandage from above downward, with a splint in front of the arm to keep it extended : and as the union of tendon is rapid, passive motion should be employed early. In rupture of the tendon of the quadriceps extensor cruris, the same treatment nearly may be adopted as for a fractured patella. Where the tendo Achillis is torn across, the treatment consists in keeping the foot extended on the leg, and the leg bent on the thigh ; a position favourable to the relaxation of the gastrocnemii muscles. For this purpose a belt is placed round the thigh a little above the knee, the back of which is attached to the heel of a slipper by means of a belt or bar. Before applying the instrument, the calf of the leg should be bandaged from above downward, care being taken not to approach too near the seat of rupture, for a great displacement and permanent defect would result from the ends of the tendon being pressed towards the bones of the leg ; somewhat the same inconvenience may occur from a too considerable or a too long-continued tilting up the heel. Desault, to avoid the displacement of the tendon by his bandage, which, like Petit's, extended over the whole limb, recommends compresses at the sides of the tendon. John Hunter, who himself had a rupture of the tendo Achillis, recommends that, as so little inconvenience attends a small separation of the tendon, compared to the great trouble and difficulties attending the treatment by bandages and straps, the parts should be allowed to remain in their natural position. He is, however, disposed to adopt a middle line of practice, and suggests that the heel should be elevated during walking, by raising the heel of the shoe ; that a bandage should be kept steadily applied to the calf of the leg, to guard against involuntary actions of the muscles ; and that at night the usual slipper and strap might be applied. There would be so little objection, however, in most cases, to a patient with such an injury remaining in bed for the few weeks necessary for repair, that probably this would be the best line to take, keeping the leg flexed over the thigh, and the heel drawn up with the slipper. Bandages are not well borne ; rest, therefore, with position, must be trusted to for the cure.

Inflammation of tendons.—Tendons being formed of highly developed fibrous tissue but little vascular, and having no active functions in the economy, are almost exempted from primary inflammation. As the result of injury to their fibres from stretching or tearing, they may primarily become the seat of plastic changes to a greater or less extent, which differ in degree only from what has been described in speaking of ruptured tendons (p. 171). Secondarily, tendons may become inflamed as a consequence of inflammation of the synovial lining of their sheaths, as we shall see in speaking of affections of the latter and the bursæ.

Tumours of tendons.—For the same reason that tendons are rarely affected with primary inflammation, they are rarely the seat of primary new growths. And not only this, but they resist for a long time the invasion of those neoplasms which attack them from without. The only indigenous neoplasms met with in them commonly are enchondromata, which may here attain some size. Some of the bursal tumours closely related to the tendons may appear to spring from them, but careful dissection will show their independence. Small nodules of bone are also found here generally near the insertion of the tendons, and are apparently due to ossification of small enchondromata, or to inflammation (*vide* p. 169). Carcinomatous and sarcomatous growths are almost unknown.

Gummata are not common in tendons, but are met with occasionally. They are deposited here between the fasciculi as in the case of muscle. When present thus, they indicate an advanced stage of the constitutional disease, and a condition generally which resists treatment. The latter will be the same as that for the other advanced tertiary lesions of syphilis, and will require to be carefully conducted.

Synovial sheaths.—Besides those of the joints, there are two kinds of synovial sacs having a close relation to tendons which require consideration—those investing tendons, and those situated in the subcutaneous cellular tissue. These cavities, lined like the joints, are liable to the same inflammatory affections, and we find in them

consequently both acute, sub-acute, and chronic teno-synovitis, or bursitis, as it is often called in the last case, produced either by simple causes such as blows, over-exertion, &c., acting from without, or by constitutional causes acting from within (*vide* DISEASES OF JOINTS).

Simple acute teno-synovitis is not often met with, unless after great violence to a limb, when the greater injuries almost sure to be present besides withdraw our attention from the lesser. The sub-acute form is not infrequently met with as the result of over-exertion, either of the hand or foot, most commonly in the extensor sheaths. The patient notices stiffness of the part, with local tenderness and pain soon after, which on examination are found to be limited to the course of one or other of the sheaths. There will also be felt a slight crackling or creaking in the latter when the part is moved. The suffering is not great, but much local weakness is complained of as a consequence of the affection. The treatment will consist in rest to the part, with application of a few leeches or hot belladonna fomentations at first. Later on when all heat has disappeared, and only stiffness and weakness remain, the part may be painted with iodine tincture, and strapped carefully with strips of adhesive plaster overlapping in the usual way, so as to give support to the sheath. Passive motion should also be had recourse to early, but not active until the part is almost painless. Later on an elastic covering will be desirable, while the patient is exerting the member.

Simple chronic teno-synovitis is also occasionally present as the result of the latter, or from chronic irritation. Here the more active changes once present have gone, leaving some effusion and thickening in the synovial sac, as a consequence of which weakness is felt and rubbing or creaking when the tendon is moved. Blisters and other counter-irritants are called for here, and may be alternated with firm strapping for the part. Under this treatment all evidence of inflammation soon disappears, except a little roughness in the movement of the tendon, which takes longer to subside.

Ganglion.—It is as a consequence probably of this chronic simple teno-synovitis, combined with repeated over-strain of the weakened sheaths, that those fluid swellings about joints to which the name ganglia or bursal tumours is often applied, are produced. These are most frequently met with about the wrists or ankles either on the anterior or posterior aspect. Those of the hands, which may be taken as good examples, usually occur among people whose occupation leads them to make sudden and violent exertions of an irregular kind, such as wringing among laundresses, &c., at the same time that the part is exposed to extreme variations of temperature, heating and chilling, *e.g.* in laundry work. Here it would appear as though we had not only a tendency to chronic irritation of the synovial linings of the sheaths of the tendons, but actually a weakening of the fibres of the latter by distension and over-strain at the same time. This leads in simple cases to a gradual dilatation of the sheath, and its synovial sac, until a fluctuating tumour is formed, of greater or less dimensions. For instance, such a process may lead on the front of the wrist to distension of the synovial sac of the flexor tendons, and stretching of their sheath, until a fluid tumour may be felt, not only in the palm of the hand, but also above the annular ligament of the wrist. The same may be met with in the sheaths of the extensors of the thumb, behind and in front of the external malleolus, and about the hamstring tendons.

Besides the presence of the swelling in such cases, patients will complain of great weakness and a little pain on using the affected sheaths. This weakness is easily explained by the fact that the tendon is no longer tightly confined in its groove, and acts therefore at a disadvantage. Otherwise there is little abnormal about the part, and the lining and its secretion are almost as in health. It is not hot, unless in addition an attack of inflammation supervene from any cause. This is not so very uncommon, the part being once weakened. The result then will be heat, tenderness, and even redness, over the swelling, which now appears fuller than usual. In this state we find the addition of fibrinous shreds to the thick synovium, and some turbidity of the latter. Such attacks as this not infrequently give rise to the production of a considerable quantity of plastic or fibrinous material within the synovial sac. This

may either cover the walls in irregular layers, or during the movements of the parts become rolled into small flattened oval pellets like melon seeds, which can be felt through the walls of the sac as they slip about like a bag-full of peas, producing a peculiar crepitation almost unmistakable. When such a sac, then, is opened we often find such plastic matter in abundance in both these forms. These loose bodies are probably also formed occasionally by small pendulous fringes of synovial membrane thickened by plastic deposit being detached during movement of the part.

Such ganglia, if extensive, are by no means easy to treat effectively. Rest and repeated counter-irritation by blisters and iodine ointment should first be tried, in the hope that the effusion may be absorbed, and the sheath shrink back to its normal condition. In many cases it will do this, but only to return to its former state on exerting the part again. Repeated tapping, carefully conducted with hollow needle or tenotome, should then be tried, the wound each time being small and guarded against contamination. In those cases, too, where there are fibrinous deposits in the sac, the sheath cannot of course resume its original condition. Here, then, and especially if the part be inclined to attacks of inflammation, an incision is called for to evacuate all the solid contents of the sac, whatever they may be. This should be done with the strictest antiseptic precautions. The opening being made over the thinnest part of the swelling, the fibrinous bodies should be squeezed out completely, or any adherent plastic material scraped off the walls of the sac with a Volkmann's spoon. A drain tube or wisp of horse-hair should then be laid in the opening and retained there till the sac has contracted completely. This will generally require a considerable time, and will not always lead to a complete restoration of power to the part at once. But with passive motion, counter-irritants, and supports, much improvement will eventually take place. Sometimes it may be necessary to make two openings in such a sac in order, in the first place, to evacuate it completely, and in the next to drain it thoroughly until contracted.

Compound ganglion.—Another kind of 'ganglion,' often called compound, is frequently found either distinct from, or associated with, the condition just noticed. Here, during some extraordinary exertion, the weakened sheath gives way at one spot or another, and a gradual protrusion of the synovial tissues takes place through the rent. This will give rise to a tumour of larger or smaller size, usually much more tense than the first variety, but capable of being emptied as a rule by pressure into the sheath. Its growth is slow, and it is usually only troublesome from the weakness associated with it, and from the chronic irritation and simple distension of the sheath. Occasionally, if the original rent in the latter be small, it may sooner or later close again, and then we find a small elastic tumour incapable of being emptied into the sheath, by any pressure, but, from its history, position, &c., manifestly of the same nature as that last described. A puncture with a tenotome will usually decide the question, and give exit to some transparent and very thick synovial jelly.

Both these last varieties of ganglia, which are usually smaller than the first produced by simple distension of synovial sac and sheath, are usually quite amenable to treatment. They may be sometimes ruptured by simple pressure, when their contents, effused under the skin, are rapidly absorbed without inflammation. Or, if this do not succeed, a tenotome may be thrust into them, and their fluid be allowed to run out either externally or under the skin. If this be done with rigid cleanliness, no trouble will follow. When the sac is thus collapsed, it should be supported by firm pressure, and should be acted on with counter-irritants, otherwise it is apt to fill again. Two or three tappings, followed up as indicated, will generally suffice to cure the condition permanently as regards the swelling; but weakness often lasts for a considerable time.

With regard to teno-synovitis and bursitis, produced by constitutional causes, they are not unfrequently met with. Thus, in any of the pyæmic conditions, in gout or rheumatism, &c., synovitis within and swelling of the synovial sheaths or bursæ are common both in the acute, sub-acute, and chronic forms. The ætiology of these conditions being the same as that of the analogous synovial affections of joints, the reader is referred to the article on 'Diseases of the Joints.' The

general treatment, too, discussed there will cover these conditions of the sheaths and bursæ, so that nothing further need be said of them here. This specific synovitis of extra-articular synovial sacs should not be forgotten, as in the acute form it will give rise to acute effusion or abscess in parts, out of the way of the ordinary exciting causes of simple synovitis.

Acute teno-synovitis, as a consequence of the direct entrance of septic matter into the synovial sac, is a common affection. It is found frequently in that class of diseases under the old name of 'whitlow.' In that form described as *paronychia tendinosa*,[1] or *thecal abscess*, the inflammation is most dangerous. Here the most destructive changes are often brought about in one or more fingers or in the hand and arm to which the disease has extended along the synovial tracts. In many cases, the joints and bones become extensively implicated. It arises from the same causes as the other forms of paronychia, *i.e.* slight wounds or pricks with inoculation of some septic matter, often, however, without any distinct history of this, especially when the state of the health is bad. It begins with severe throbbing pain on the palmar surface of the finger, which extends along the arm, often as far as the shoulder; it is accompanied by redness and swelling, with great hardness and tension; if not checked, the inflammation proceeds quickly along the front of the finger, and is soon followed by suppuration in the sheath; this at first is in small quantity, and, in consequence of the great hardness and swelling of the part, cannot be detected by the touch; if no relief be afforded, the suppuration quickly proceeds along the sheath, the inflammation and pain are aggravated by the density and unyielding nature of the parts, and are accompanied by much constitutional disturbance; abscesses burst externally from time to time as the disease extends upwards, from which fungous granulations spring, the tendon in a sloughy state lying at the bottom. With proper treatment, and in a favourable state of the general health, the progress may be arrested with a greater or less amount of destruction of the parts attacked, and a proportionate deformity. In certain unhealthy states of the system, however, in which the diffuse or erysipelatous form of inflammation prevails, the inflammation and suppuration extend into the palm of the hand behind the palmar fascia, and to the rest of the fingers. The whole hand now presents a highly inflamed appearance, of an erysipelatous nature, with great swelling and tension; nor does the mischief end here, but, passing under the transverse ligament of the wrist, ascends into the forearm, forming large diffuse abscesses amongst its tendons and muscles; and in the worst cases, not only the joints of the finger, but those of the carpus and wrist, are destroyed, and the bones denuded and necrosed. The health during this time suffers severely from irritative fever, with gradual prostration of the bodily powers.

Treatment.—In the very early stage the inflammation may often be arrested by leeches, followed by hot belladonna fomentations to soften and relax the hard and unyielding tissues. The hand should be elevated, and an active purgative, with other antiphlogistic measures, prescribed; if relief do not soon follow, but, on the contrary, the continuance of pain and throbbing, with increased hardness, indicate the extension of the inflammation, if not the formation of pus, no further time must be lost; a free incision must be made along the centre of the finger, and though there may be but very little or no pus in the sheath, yet the division of the tensely strangulated structure, and the escape of blood and serum, afford the greatest relief. By these means all mischief may be arrested, and the finger perfectly restored; especially if the incisions have been made with all antiseptic precautions. On the other hand, the inflammation may proceed along the sheath in spite of the most ready treatment; suppuration may have extended under the palmar fascia; further incisions must then be made; and it will now be found proper to support the powers of the system by a generous diet, stimuli, and tonics. In these cases the tendon will slough, and one or more of the joints will be anchylosed, with such disfiguration as may at a future time require amputation; for a stiff and distorted finger, in almost any condition of life, is very inconvenient as well as unsightly. In the more chronic states, where, notwithstanding free openings having been made in the palm, abscesses

[1] Abernethy, *loc. cit.*

burrow about the hand, the best results follow from constant immersion of the part in hot water, to which some non-irritating antiseptic has been added, alternating with hot boracic fomentations, the powers being supported with tonics, good diet, and stimuli. Where the suppuration extends to the arm, the case is more serious; and if, from the state of the constitution before alluded to, it proceeds to the indiscriminate destruction of the joints, nothing but amputation remains, and even that may not save life.

Diseases of Bursæ.—Turning to the affections of the bursæ proper, we find them analogous in almost all respects to those of the synovial sheaths of tendons. We encounter in them both simple and specific synovitis, whether acute, subacute, or chronic, and producing very similar, if not identical, grosser effects. Thus we have effusion in every degree, from a trifling excess of synovium to the production of pus; or, in the chronic form, from slight thickening, with roughening of the internal bursal surface, to the deposit of vast masses of fibrinous material within the sac, either covering its walls, or rolled and worked by movement into those melon-seed bodies already alluded to (p. 174). But, although almost any of the bursæ mucosæ of the body may be affected, there are a few which so frequently come under our notice as to call for a few moments of special consideration. The bursa patellæ is one of these, its simple affections being usually grouped under the name of 'housemaid's knee,' so frequent is it in this class. Here it is usually brought on by kneeling, and may be, as already said, acute, sub-acute, or chronic. In the first, early antiseptic evacuation of the effusion is the best practice, if there be any suspicion of its being purulent, lest, as most surgeons must have seen, the collection burst subcutaneously and produce extensive abscess around and about the knee, threatening the joint. In the less severe forms rest, with antiphlogistics, as already indicated, will usually suffice to relieve the patient. In the chronic form, where there is much fibrinous deposit in the joint, and the part is painful, it is usually the best practice to dissect out the whole sac bodily, with all precautions as to aseptic wounds. This may be easily done by a single vertical incision, the hard round body coming away without difficulty, and leaving a clean healthy cavity behind to unite by first intention. The objection to leaving these greatly thickened bursæ patellæ alone is that the constant pressure of the hard mass under the skin, with the rubbing and pressure to which the latter is subject, will in many cases lead to ulceration, leading either into or from the rugged cavity within the fibrinous mass. If this take place, unhealthy sinuses may exist for long periods, discharging curdy, broken-down fibrin; or the inflammation may spread from the now open sac to the tissues around, giving rise to much trouble and some danger.

In those cases where there is a simple effusion of serous synovium into the sac which resists the action of counter-irritants, the treatment will consist in simple tapping with a needle or tenotome, with subsequent strapping of the part. If after this there remain much induration of the walls, with a tendency to refill, a free opening and aseptic drainage, as described for the ganglia, may be tried before proceeding to enucleation of the whole sac.

What has just been said of the bursa patellæ applies equally to the affections of that over the olecranon, which are also grouped commonly under the name of 'miner's elbow,' from the frequency of these conditions among those who work long on their hands and knees. Here the fibrinous exudation is not so likely to be troublesome; but in other respects the conditions and their treatment will be the same.

Again, the bursa between the ligamentum patellæ and tibia sometimes enlarges and forms a tumour, which, by filling up the depression on each side of the ligament, presents the appearance at first of synovitis of the knee-joint; but the absence of swelling above and around the patella renders the diagnosis easy. Distension of the bursa above the knee usually accompanies synovitis, because this bursa almost always communicates with the joint; this, however, is not always the case, and large bursal tumours under the vasti have been seen, the joint being quite healthy. One of the bursæ of the hamstring muscles (usually that of the biceps) occasionally enlarges, and appears in the ham as a tumour, sometimes pulsating, often of considerable size; it is, however, too little like an aneurism to be mistaken for one by a careful observer. The

same may be said of the bursa of the subscapularis, and other sacs about the shoulder-joint, which sometimes form tumours in the axilla, occasionally pulsating from their vicinity to the artery. The bursa between the psoas and iliacus internus and the capsule of the hip-joint sometimes forms a tumour, which from its situation may be mistaken either for an inguinal aneurism or for a psoas abscess; the extrinsic character of the pulsation and the absence of all other aneurismal symptoms in the one case, and the want of spinal symptoms and of fluctuation above Poupart's ligament in the other, assist in forming a right diagnosis. This bursa occasionally communicates with the synovial membrane of the joint, and when inflammation occurs in the former, the latter will most likely be involved in it, and serious mischief may follow. The bursa between the glutæus maximus and tuber ischii, that between the tendon of the glutæus medius and the trochanter, and that between the latissimus dorsi and the angle of the scapula, from their exposure to pressure and other sources of irritation and inflammation, are not only liable to inflame, but even to suppurate. When, from frequently recurring pressure in sitting, the already enlarged ischio-gluteal bursa inflames and suppurates, it increases in size, becomes painful, and renders sitting on the part impossible, and even motion distressing; lying deep under the mass of muscle, its fluctuation is obscure, and the suppuration is usually slow in coming to the surface, and after it is evacuated, it often leaves a sinus obstinate and slow to heal, from its depth and the movements of the muscle. The same may be said in most respects of the bursa over the trochanter. That at the angle of the scapula often acquires a great size, and when it suppurates, much constitutional disturbance is often set up. Too much caution cannot be taken in opening these bursæ, whether in their simply enlarged state or in the suppurating stage, as an alarming and even fatal train of symptoms sometimes follows the operation.[1]

J. Lockhart Clarke, 1870.
Arthur E. Barker, 1882.

[1] On the diagnosis between diseases of the bursæ and of the joints, see Diseases of the Joints.

DISEASES AND INJURIES OF NERVES.

PART I.

NERVE-LESIONS AND THEIR MORE IMMEDIATE EFFECTS.

Diseases of Nerves.

NERVES are subject to as many disorders and injuries as most of the other tissues of the body. They are liable to inflammation, suppuration, ulceration, and gangrene; to atrophy and enlargement; to softening and induration; to the formation of cysts, fibrous or neuromatous tumours, and cancerous growths along their course; to compression or stretching; to contusions, lacerations, punctures, and partial or complete division.

Inflammation of Nerves (Neuritis).

Neuritis is not as common an affection as supposed by Remak and Benedikt, who believe that it exists in most cases of neuralgia and other neuroses. In animals, as shown by Vulpian and Weir Mitchell, it is extremely difficult to produce an inflammation of nerves, and in man it is not rare to find nerves surrounded by the pus of a large abscess without any inflammation except of their outer sheath. Still, a prick, a contusion, a prolonged pressure, an inflammation of neighbouring tissues, are well-known causes of neuritis. General causes also can produce neuritis, as seen in typhoid and eruptive fevers, alcoholism, syphilis, leprosy, poisoning by lead or the oxide of carbon, diphtheria (Buhl). Diseases of the brain will also bring on neuritis, as shown by L. Türck, Vulpian, Charcot, Bouchard, Westphal and others. Optic neuritis is known to be often due to cerebral tumours (J. Hughlings Jackson, Galezowsky). Localised spinal meningitis may also be a cause of neuritis, as one of the writers (Dr. B.-S.) has seen in two cases. The only known cause of neuritis outside of cases of diseases or injuries of the nervous system, or of an alteration of the blood, is an influence exerted by cold or dampness.

Pathological anatomy of neuritis.—In its *acute* form this affection is characterised by redness, swelling and serous exudation of the cellular tissue of nerves. Intense congestion exists both of the outer sheath and that of the fascicles of the inflamed nerve, with or without punctiform ecchymoses. When the inflammation is very intense the nerve is softened, disaggregated, and the altered nerve-tubes form a brownish, soft mass. The morbid process may be more advanced, so that only fragments of the nerve-tubes can be found, and sometimes degenerated into fat. However, in ordinary acute neuritis, especially when due to inflammation of neighbouring tissues, nerve-fibres may remain perfectly normal, as shown by Cornil and Ranvier, owing to the protection of the cellular sheaths of the nerve, keeping pus outside of these nerve-elements. Such is frequently the case in secondary peri or interstitial neuritis. Charcot, Pierret and Joffroy have described a very rare form of neuritis (*parenchymatous*), characterised by the moniliform appearance of nerve-tubes, the proliferation of the cells belonging to the segments of these tubes, and the disappearance of the cylinder axis. In its *chronic* form neuritis is characterised by the greyish, bluish, or almost violet colour of the affected nerve, which is swollen and offers nodosities. The neurilemma adheres to surrounding tissues. If the inflammation is limited to that

membrane (*perineuritis*), the nerve-fibres remain generally quite normal, but if it extends to the interstitial sheaths, there is pressure on the nerve-tubes and consequently atrophic degeneration.

Acute neuritis is often preceded by the usual prodromata of inflammation. Its characteristic symptoms consist of a tearing, darting, or lancinating pain chiefly along the course of a nerve-trunk or its branches, but also along the neighbouring nerves, attended with a sensation of tingling, formication, or numbness. The pain never becomes *suddenly* severe or ceases suddenly, or intermits, as in neuralgia; for although it frequently remits or abates, it is a continuous pain which gradually increases in intensity and gradually subsides. It is always aggravated by pressure on the inflamed portion of the nerve, by contraction of the muscles to which it distributes branches, or even by the slightest touch along its peripheral course; while, on the other hand, it is relieved by firm pressure above the seat of the inflammation. If the affected nerve is superficial, its swelling, hardness and nodosity are easily recognised, and these altered parts are found to be the principal seats of pain. A period of general hyperæsthesia may exist in the beginning, but is usually soon replaced by anæsthesia in almost all the parts receiving nerve-fibres from the affected nerve, the loss of feeling co-existing then with the radiating pains. This association of pain and anæsthesia is found in ordinary acute neuritis, in *ophthalmic zona* (Hybord), and in *Lepra anæsthetica* (Rendu), affections in which a real acute neuritis exists. Sometimes there is a change in the skin at or near the principal seat of inflammation of the nerve. There is a red swelling, which may be mistaken for a boil, but, as shown by Remak, it changes rapidly in size and colour, so that it cannot long be a cause of mistake. The local motor symptoms are variable :— there may be trembling, twitching, cramps, choreiform or tetaniform contractions; there may be, on the contrary, a more or less complete local paralysis. The vaso-motor nervous system is often disturbed, so that there is a vascular contracture or dilatation. In a case now under the care of one of the writers (Dr. Brown-Séquard) there is vascular contraction with great coldness in one part, while there is dilatation with increase of temperature in another. Friedreich, Klemm, Vulpian and Erb have ascertained that acute neuritis often causes rapid muscular atrophy. One of the writers (Dr. B.-S.) has seen a marked atrophy of the muscles of the thigh and leg, occurring in two days in a dog. That atrophy is produced by a direct morbid influence exerted by the irritated nerve on the nutrition of muscles, as maintained by one of the writers, but Vulpian believes that it is due to a cessation of the proper trophic influence of the spinal cord on muscles. Faradisation soon ceases to act on muscles becoming atrophied. But in the beginning of acute neuritis, galvanism may act with great power (Erb). The pulse is frequently strong and quick, the temperature of the skin over the inflamed part is much increased, and there is generally a variable degree of sympathetic fever, in proportion to the size of the affected nerve and the intensity of the inflammation. A great variety of local alterations of nutrition have been noticed in acute neuritis. We will only point out the existence of the following: bullæ or vesicular eruptions (Rouget, Charcot, Sir James Paget, Earl, Raynaud, Mougeot, Couyba, Weir Mitchell), sometimes pemphigus (Charcot), eczema (Mitchell), ulceration (Paget, Hutchinson, Brown-Séquard), glossy skin (Paget, Mitchell), fall of hair, nails clubbed, scaly, cracked and fragile (Mitchell and others), ichthyosis (Brown-Séquard), atrophy or hypertrophy of skin (Charcot, Mitchell, Brown-Séquard). The remote and the reflex symptoms will be described in the second part of this article.

Chronic neuritis may either result from incomplete resolution of acute inflammation, or be the continuation of a milder form. In either case it is a frequent cause of certain kinds of neuralgia, of neuroma, and painful subcutaneous tubercle.

Idiopathic neuritis, although much less common than traumatic, is, we believe, more frequent than it is generally considered to be. Its chief exciting causes are exposure to cold, to damp, and particularly to the combination of both; the suppression of profuse perspiration; the arrest of hæmorrhoidal discharges; excessive bodily fatigue; strumous or tubercular affections, and sometimes visceral inflammations and suppurations.

Traumatic neuritis is much more common than idiopathic. As the term implies, it is the result of some external injury, such as wounds, contusions, fractures, dislocations, surgical operations, &c. According to the observations of one of the writers (Dr. L. C.), it is less frequently fatal than the idiopathic form.

Diagnosis.—Although several of the symptoms of muscular rheumatism, of thrombosis or embolism, and of phlegmatia alba dolens have some analogy with those of neuritis, a mistake can hardly be made. Not so always as regards a distinction between a neuralgia and neuritis, but the constancy or permanency of pain in neuritis, and the absence of local signs of inflammation of a nerve in neuralgia, will help the diagnosis, if otherwise obscure.

Treatment of neuritis.—The most important remedies to be employed in the treatment of *acute* neuritis, are the local abstraction of blood by means of cupping or leeches; evaporating lotions or anodyne fomentations; a spare diet with the use of purgatives; tartarated antimony, opiates, belladonna, and the preparations of aconite. When there is reason to believe that the inflammation is of a gouty, rheumatic, or syphilitic character, colchicum, iodide of potassium, or perhaps mercury, should be employed. In cases where it is complicated with serious internal disease, or associated with a low cachectic condition, the treatment must be modified accordingly.

In *chronic* neuritis repeated blisters along the course of the nerve sometimes afford great relief. Anodyne fomentations, and especially liniments of aconite, belladonna, chloroform, and opium, are frequently of signal service. At the same time attention must be directed to the state of the general health. Vegetable and mineral tonics, iodide of potassium, and mild aperients are sometimes indispensable.

In the various kinds of neuritis, either acute or chronic, one of the writers (Dr. B.-S.) has employed, with great benefit, three means of treatment (applications of ice, of the actual cautery, and of descending continuous galvanic currents), which will be described in the second part of this article.

Ulceration of nerves, as a primary affection, appears to be unknown; but nerves in the neighbourhood of ulcers are liable to become involved in the morbid process, and then they are generally the cause of intense and protracted suffering.[1] In such cases, the surrounding soft parts are often enlarged, the skin increases in thickness, the muscles and tendons share in the ulceration, and even the bones increase in dimensions. On either side of their ulcerated portion the nerves are generally thickened, sometimes to nearly double their natural diameter.

When these ulcers are exceedingly painful, Mr. Swan recommends the use of ointment made with powdered opium, or lotions made by mixing well-powdered-opium with water, or lime-water. These should be applied on lint, and then a folded cloth moistened with water, or laudanum and water, should be placed over the surrounding skin; at the same time the digestive organs should be regulated. When other remedies have failed, and the disease is confined to the soft parts, excision of a portion of the nerve will be advisable, but if the bone be affected by caries or necrosis, amputation may be necessary. Mr. Swan recommends, that in excising a portion of the nerve, the operation should be performed as far as possible from the ulcer, because there is then a much greater probability that the external wound will heal by the first intention, and that consequently the cut ends of the nerve will escape inflammation and ulceration. It is also advisable to divide the nerve as near the upper part of the wound as possible, as the end of the nerve will thus retract from the wound, and consequently be less liable to become inflamed, should the external parts have assumed this disposition.

[1] Nerves sometimes ulcerate in consequence of the pressure of tumours, &c. A striking case of ulceration of the sciatic nerve, produced by pressure of an aneurism, which extended backward from the right groin, is recorded by Morgagni, *De causis et sed Morb.*, epist. 50, p. 11.

Tumours of Nerves.

All kinds of tumours have been found in connection with nerves, but by far the most frequent is that which constitutes the general group of *Neuromata*. This group is, however, an ill-defined one, as it embraces widely different kinds of morbid growths. For the sake of clearness we will divide what relates to *neuromata* into three sub-groups: 1st, the genuine *neuroma*; 2nd, the various *neuromata*, containing no new nervous elements, but seated in or on a nerve; 3rd, the *painful subcutaneous tubercle*, which only differs from the other neuromata by its location and size.

Neuroma.—True *neuroma* has not been known for a long time. Verneuil, in 1854 and 1855, first saw that some neuromata contain nerve-fibres of new formation; but it was left to Fuehrer (1856) to establish that there is a kind of neuroma almost entirely formed of new nerve-fibres, and that the name of neuroma ought to be employed exclusively for that special kind of tumour. Weld and Virchow added to the demonstration the result of their examination of the kind of neuroma developed at the cut end of nerves in stumps. They found that swollen end composed chiefly of nerve-fibres. Foerster (1865) went further, and showed that there are two kinds of true neuroma, one formed of a substance similar to that of the grey matter of the nervous centres, and containing genuine multipolar and bipolar nerve-cells, with processes going to the affected nerve; and the other formed chiefly of new nerve-fibres spread about in every direction, and mixed in very various proportions with conjunctive tissue. Foerster maintains that the word *neuroma* ought to be kept expressly for those two kinds of tumour, and that the other tumours developed on nerves must be named according to the nature of the tissue composing them: fibroma, myxoma, &c. No real neuroma has yet been found elsewhere than in or on nerves. In some true neuromata the different stages of development of nerve-fibres have been found. The fibres of the affected nerve generally remain quite distinct from the new nerve-tubes; they form bundles either on one side of the tumour, or they pass through it when they are not scattered on its surface. Virchow has shown that a true neuroma often has other anatomical elements in such a quantity that the tumour, according to the kind of those elements, ought to be called a *glio-neuroma*, a *fibro-neuroma*, a *myxo-neuroma*, &c. A true neuroma can become a mere fibroma, owing to the atrophy of the new nerve-tubes squeezed by fibrous tissue. Neuroma is usually a round or oval tumour, varying from the size of a pea to that of a filbert; but it may be as large as a hen's egg. It is generally hard, and has a smooth surface. It may appear only in one place; or it may exist not only on many nerves, but also on most nerves of the body. Virchow divides the true neuromata into three groups: the traumatic, the congenital, and the spontaneous. The ordinary origin of a traumatic neuroma is a prick of a nerve, the pressure exerted by cicatricial tissue on the cut end of a nerve in a stump, and the ligature of a nerve. Other causes, however, can produce it; such as a section of a nerve, as in a case of Weissmann, or a contusion, as in a case of Dehler.

False neuromata.—This group contains all the cases of tumour of nerves, having the external appearance of a true neuroma, and shown to be different only, or almost only, when after extirpation an anatomical investigation is made. As the symptoms caused by a false neuroma, and as also the causes producing it, are pretty much the same as those of a true one, there is no possibility of establishing a diagnosis between true and false neuromata. But as the treatment is to be the same anyhow, we cannot regret the impossibility of such a diagnosis. Tumours of nerves composed of pure fibrous tissue or fibro-plastic elements are those which are generally mistaken for true neuromata; but this has been the case also when the tumour was a myoma, a myxoma, an angioma, or even when it was composed chiefly of fibro-cartilaginous tissue.[1]

[1] In the second edition of this work, one of the writers (Dr. L. C.) gave the following account of his examination of a false neuroma. He says: 'On examination under the micro-

Painful subcutaneous tubercle.—Since William Wood (1812) gave that name to a group of tumours (well described already by Camper and others), it has been ascertained that these morbid growths, as well as the generally small tumours developed in or on a subcutaneous nerve, ought not to be separated anatomically from the neuromata. Their only essential difference is their location, which is entirely under the skin, or partly in and under it, instead of being deeper. They are to be divided into two groups as the other neuromata: the true, composed chiefly or partly of new nerve-fibres; and the false, composed of a great variety of anatomical elements. They are more often due to a contusion than the deeper-seated neuromata.

Symptoms of neuromata.—Sometimes a neuroma, or even a subcutaneous tubercle, is painless, at least for a long time, but even then there is almost always considerable tenderness under pressure of the tumour, and what is more characteristic, there are in a marked degree the peculiar sensations which we will describe as caused by compression of nerves. The existence of a tumour, especially where we know that there is the trunk of a nerve, together with the production of local pain and of those characteristic sensations, is enough for the diagnosis of a neuroma. Generally, we might say almost always, pain exists, and sometimes in a very high degree. The pain shoots from the seat of the tumour, and radiates towards all the parts to which are distributed the ramifications of the nerve. The pain is sometimes continuous, but generally with periods of great and often sudden increase. In other cases the pain disappears at times, and only recurs by attacks of more or less violence. During the paroxysm any contact of the skin in parts receiving ramifications of the nerve increases the pain; but a firm pressure on the trunk of that nerve above the tumour, gives rapid relief. It is not rare that other nerves near, or even at some distance from the diseased one, are sympathetically affected, so that a more or less distant neuralgia becomes associated with the pains of the neuroma. Sometimes local movements are produced during a paroxysm of pain. In other cases local or general hysterical, choreic, or epileptiform convulsions are produced by the constant irritation of the diseased nerve. In cases of subcutaneous painful tubercle, the existence of the tumour is found out more easily than in the case of deep-seated neuromata. It is a source of the most acute pains, which dart like electric shocks along the course of the nerve, sometimes in both a peripheral and central direction. The pains recur very irregularly, and last, at each attack, from ten minutes to two hours or more. They begin gradually, increase in intensity, and gradually decrease, leaving the tubercle and its surrounding parts more or less tender to the touch. They are frequently excited or aggravated by changes in the weather from hot to cold, or the reverse, by storms, &c., and sometimes by mental emotions. The paroxysms may be repeated several times a day, or there may be remissions of days or even weeks. In all cases of obstinate neuralgia, especially of the extremities, a careful search should be made for the possible existence of subcutaneous tubercles.

Treatment of neuromata and subcutaneous tubercles.—The only effectual remedy for these morbid growths is the knife. The operation will consist of excision of the tumour, with or without a portion of the diseased nerve. When the neuroma is very intimately connected with the nerve, and there is reason to believe that it cannot

scope, it was found to be everywhere composed of a multitude of nuclei, with some nucleated cells, and an abundance of fibrous tissue. Some of the nuclei were more or less oval, but the majority were round, and measured about the $\frac{1}{3500}$th of an inch in diameter. Amongst these were other bodies of the same nature, but of all degrees of smaller size, and either elongated, angular, or in the form of granules. The nucleated *cells* were of very small size, and very granular in structure. A few of them were sparingly scattered through the tissue, but, for the most part, they were collected here and there into small, oval, or circular groups. Between these elementary bodies there was an abundance of ordinary fibrous tissue. The fibres were generally more or less tortuous, but parallel, and in their course each divided again and again into finer filaments, which were connected with the cells and with all the other elementary bodies; the granules and the angular or elongated nuclei filling up the interspaces between those that were oval or round; and thus contributing to form with these and the fibres, a close, uninterrupted, and *reticular* structure.'

be extricated from the nerve without great disturbance or injury, it is better to remove a portion of the nerve with it. With regard to the trunk of the sciatic nerve, which supplies so great a part of the limb, excision of a portion of its length would be attended with serious consequences, and therefore the operation ought to be delayed considerably. If, after the excision has been made for many months, regeneration of the nerve occurs, it may become advisable to amputate the limb.

Tubercle.—Dupuytren and Cruveilhier have spoken of tubercle in nerves, but there appears to be no evidence to prove that it is ever found in this situation as a primary disease; although nerves are sometimes destroyed by the softening of tubercles in which they are involved.

Cancer, unlike tubercle, is frequently met with in nerves, both as a primary and secondary affection. The form of the cancer is in general either the white medullary, or melanosis. It may occur at any part in the course of a nerve, but it is mostly found near its peripheral extremities. It generally grows to a considerable size, as in medullary cancer of the retina. As a secondary disease it is communicated to the nerve by a contiguous cancerous growth.

Dubois, on several occasions, found cancerous growths in the substance of nerves of both the arms and legs. Moutard-Martin saw one on the median nerve, and its removal was followed by cancer of the brain. Dupuytren removed one from the posterior tibial nerve, which, moreover, presented a series of nodulations, like grape-stones. It was the cause of acute lancinating pains. In another case he found the trifacial nerve transformed into encephaloid substance. Cancerous growths have been found, also, on separate branches of the trifacial, on the spheno-palatine ganglion, on the optic nerves, and on the phrenic nerves.

Cysts.—A tumour on nerves may consist of a single cyst containing a gelatinous fluid, or of a larger mass of ordinary structure containing a number of cysts.[1]

Hypertrophy of nerves, in the proper sense of the term, has no actual existence as a *morbid* condition. It is true, as we have already seen, that the inflamed portion of a nerve frequently increases considerably in size; but this increase is the consequence of morbid products and exudations that are poured into the neurilemma and connective tissue between its fibres, which instead of being multiplied or enlarged, sometimes undergo, from compression and impaired nutrition, decided wasting and disintegration.

Atrophy of nerves may be either general or local. General atrophy is found only in cases of extreme and protracted emaciation, from defect of general nutrition. Local atrophy may be the result of several different causes, viz., chronic inflammation, stretching, compression, and even severe contusions. Of these the most common is compression caused by tumours, aneurisms, enlarged glands, &c. Nerves of special sense often waste after loss or wasting of the central organs to which they belong, as the optic nerve after wasting of the globe of the eye. In some instances the nerve-fibres only are implicated, and nothing may be left but the neurilemma; in others the neurilemma itself is involved in a greater or less degree. During the process of atrophy, the nerve-fibres become uneven; their white substance is broken, at intervals, and stripped from their axis-cylinders in masses, which again break up into smaller fragments that are mingled with fatty particles. A spontaneous atrophy of nerves has been studied by Leber, Jaccoud, and others. It has been found chiefly in old age, and in the optic more frequently than in other nerves. No organic cause has been discovered for that special kind of atrophy in which the nerve-fibres become small, dry, rigid, but are otherwise almost normal.

[1] In the Museum of St. George's Hospital (Ser. viii. No. 152) there is a preparation showing a cyst on the median nerve of a patient who had suffered the most excruciating pain in the arm.

Injuries of Nerves.

Contusions.—The experimental researches of Tillaux, Weir Mitchell, and those also of Arloing and Tripier, have shown that wounds, producing a paralysis in consequence of a mere contusion of a nerve, do not alter, at least at first, a number of its fibres, and that the degree of paralysis is often due to a temporary pressure on the nerve by effused blood. In man, contusion of nerves rarely occurs, when the parts (skin, cellular tissue, &c.) covering them have not been lacerated. Contusions of nerves are frequently followed very insidiously by the most serious consequences. If the blow be not very severe, the principal change produced in the nerve is the extravasation of blood and other fluids into the connective tissue between its bundles. There is pain, numbness, tingling, or formication in the parts supplied by its branches, followed, in a greater or less degree, by partial and temporary paralysis, and atrophy of the muscles. If the contusion be very violent, the fibres of the nerve may be lacerated or crushed, and then the atrophy and paralysis are of a much more serious character, and may follow the injury either immediately, or not till after an interval of weeks or even months. As we have already seen, tumours are liable to form on nerves that have been contused.

Compression.—Experiments of great value have been made on the effects of compression of nerves by Vulpian and Bastien, Aug. Waller and Weir Mitchell. The two first of these observers, experimenting on themselves, have minutely described the symptoms taking place. Very hard pressure on a nerve of a limb being continued for a long time, they found that during a time of from two to ten minutes, there were cramps, with feelings of pricking and formication, and sensations of heat. A period of diminution of these effects was next observed, lasting from a few seconds to an hour. Next appeared hyperæsthesia, soon diminished and even replaced by anæsthesia, with pains, and especially a burning sensation. Besides, to paralysis soon completed, succeeded a sensation of fatigue. The compression having ceased, the pains and morbid sensations quickly disappeared; but the paralysis and anæsthesia persisted for a variable time, after which voluntary movement became possible. A little later, all kinds of sensibility excepting that to heat and cold returned. The next symptoms were a feeling of coldness arising from the periphery of the nerve, with a sensation of weight rendering movement difficult, and a general *malaise* (uneasiness) increasing sometimes to faintness. Then an extreme excitability occurred, and there were local spasms, with a reappearance of prickly feelings and formication. Slowly the normal state returned. Aug. Waller has obtained very nearly the same effects, but he has ascertained that paralysis appears not only in the muscles receiving fibres from the compressed nerve, but also in some more or less distant nerves. Weir Mitchell agrees with Waller. Some of the symptoms produced in these experiments appear not rarely in people who have had a pressure on a nerve from a wrong position of a limb during sleep, a ligature round a finger or a limb, a bridle in a prolonged ride, the handle of a basket, a crutch (Mitchell's crutch palsy), the forceps on the head of a fœtus, or on the pelvic nerves, the head of a fœtus on those nerves, a vicious cicatrix, an abnormal callus, a displaced bone after a fracture or a dislocation, a tumour, an abscess, &c. Of these causes, dislocation of large joints, and the attempts made at reduction, are among the most common. The effects are more serious in proportion to the length of time before the dislocation is reduced. Sensibility suffers much less than the power of motion. If compression of a nerve be severe and long continued, it may give rise to incurable paralysis and wasting of muscles. When the injury is not so severe, it causes pain of a more or less acute, and more or less constant, character, attended sometimes with a feeling of numbness or tingling. Nerves may be compressed, also, by aneurisms; by tumours of different kinds, formed either upon them, or in their immediate neighbourhood; by enlarged glands or bursæ; by abscesses; by cancerous growths; by fæcal distension of the rectum and sigmoid flexure of the colon; by hæmorrhoids, and other causes.

Sir B. Brodie relates the interesting case of a man who had severe pain on the inside of his knee. No marks of disease could be detected in the joint, but in the thigh there was an aneurism of the femoral artery. Sir E. Home applied a ligature round the artery in the upper part of the thigh; the tumour immediately ceased to pulsate, and the pain in the knee ceased also.[1] The remarkable case related by Morgagni, of aneurism in the right groin pressing on the sciatic nerve and producing ulceration with intense pain, has been already quoted. Scarpa also describes an interesting case of aneurism of the abdominal aorta, causing disorganisation of the lumbar nerves and injury to the anterior crural and obturator nerves.[2]

Tumours in the immediate neighbourhood of nerves are frequently, by the pressure which they exert, the cause of as much suffering as those which are formed upon them.

Sir B. Brodie mentions the case of a gentleman who suffered severe and increasing pain in the left leg, from the foot to the knee, in the course of the peroneal nerve. As the limb presented no morbid appearance, the disease went by the name of neuralgia. After a considerable time the patient died of dropsy, and on opening the abdomen, a large solid tumour was found attached to the left side of the lumbar vertebræ. It was evident that this tumour must have pressed on the origin of the sciatic nerve.[3] Mr. Travers published an interesting case of compression of nerves by medullary tumour in the ham;[4] and Sir William Lawrence mentions the case of a tumour in the forearm of a gentleman, situated over the course of the ulnar nerve, and causing exquisite pains, like electric shocks, upwards and downwards, in the direction of the nerve.[5] Mr. Morris has recorded a most remarkable case of ungovernable satyriasis, excited apparently from pressure on the internal pudic nerve made by a tumour that arose from a blow on the perinæum.[6]

Tumours of this description are liable to be mistaken for neuromata, or for those tumours which are formed on nerves or in their substance; but a correct diagnosis may generally be made by moving the tumour in different directions. If the tumour be free, pain will be felt only when it is pressed in the direction of the nerve.

Enlarged glands are not unfrequently the cause of compression and distension of nerves; and there is no nerve so frequently affected in this way as the facial. Several cases of this description were published by Sir Charles Bell.[7]

Sir B. Brodie mentions a case in which 'two lymphatic glands, enlarged to the size of large walnuts, were found situated beneath the skin, on the anterior part of the thigh.' A considerable branch of the lumbar nerves lay over each of these glands, being thus kept stretched like strings of a violin over its bridge, and giving rise to violent pain and convulsive movements of the leg.[8]

The same author mentions a case of severe neuralgia in the foot, caused by the descent and pressure of internal hæmorrhoids, after each evacuation from the bowels.[9] Romberg calls particular attention to neuralgia of the obturator nerve caused by crural hernia, and gives a long but interesting case in illustration.[10]

Pain of a very acute kind is more often excited by small interstitial growths in nerves, than by large tumours over which the nerve-fibres are stretched; for nerves when submitted to a slow distension may be stretched to a very considerable extent without exciting any painful sensation, until they become inflamed, or their nutrition be impaired, when the slightest touch causes acute pain. It therefore seems highly probable that the painful effects of slow compression and distension, by whatever means they may be produced, are in many instances the result of inflammation or some peculiar kinds of irritation which has been excited. When nerves are bruised or otherwise injured at their exit from a foramen or bony canal, they are very liable to cause suffering, because in the event of inflammatory swelling, they are sure to be compressed.

Laceration of nerves occasionally takes place from different kinds of causes, such

[1] Sir B. C. Brodie's *Works*, collected by C. Hawkins, 1865, vol. iii. p. 135.
[2] *Treatise on Aneurism*, translated by Wishart, p. 99.
[3] *Works*, vol. iii. p. 135.
[4] *Med.-Chir. Trans.* vol. xvii. p. 389.
[5] *Ibid.* [6] *Trans. of Medical Society of London*, vol. i. part i. p. 174.
[7] *Nervous System*, appendix; [8] *Works*, vol. iii. p. 139.
[9] *Ibid.* p. 141. [10] Romberg, *Nervous Diseases of Man*, vol. i. p. 75.

as accidents by machines, heavy falls, fractures of bones, dislocation of joints and attempts at reducing them. It is somewhat surprising, that, except in parts that are vitally important, laceration of nerves is not followed by serious consequences so often as might be expected.

Béclard has related many cases of this description.[1] Flaubert mentions a case in which the last four nerves of the brachial plexus were torn from the spinal marrow, by violent extension in attempting to reduce a dislocation of the shoulder-joint. The patient died at the end of eighteen days.[2] In St. George's Hospital Museum,[3] there is a preparation showing the anterior root of one of the cervical nerves torn from the spinal cord, by dislocation of the vertebræ in a heavy fall.

Ligature of nerves.—It sometimes happens that in tying an artery a nerve is accidentally included in the ligature. In certain cases this accident has been followed by severe local disturbance, and even by fatal effects. Many instances of tetanus resulting from the same cause, after amputation, have been recorded by several writers. When pain is referred to the amputated limb along the distribution of a particular nerve, there is reason to suppose that this nerve has been included in a ligature; and if on pulling at the ligature the pain experienced be aggravated, there can no longer be any doubt as to its cause. Under these circumstances, if tetanus or any other alarming constitutional disturbance be threatened, the ligature should be immediately removed.

Hennen gives a most interesting account of the effects of ligatures on nerves, in the case of a general officer who suffered amputation of an arm, which was destroyed by a bullet in action. After the occurrence of fever and extensive sloughing, an attempt at clearing the ligatures was attended with the most excruciating pain. 'He has,' says Dr. Hennen, 'frequently, after the smarting of dressing was over, with great accuracy pointed out on my arm the course of the internal cutaneous nerve, as the site of his ideal pain; often he has described that of the external; and on one occasion, I, with utter astonishment, had the general neurology of my arm and fingers traced by him. Once only did I ever know him to refer his pain to the sensorium itself. On that occasion, from using an artery forceps to the ligature, on which the slide moved rather stiffly, I exerted a greater force than I intended. He convulsively put his hand to the head, expressed a sense of exquisite pain in his brain, involuntary tears dropped from his eyes, a paralytic contraction momentarily affected his mouth, an universal paleness spread over the uncovered part of his body, and he uttered a piercing cry, exclaiming that the agony of his head and mouth was insufferable. The state of collapse was so great, that I was obliged to send an aide-de-camp instantly for volatile alkali and a glass of Madeira, by which he was soon relieved; but the painful sensation, and the prostration of his strength, continued through the day.'[4]

Complete division of nerves.—The effects of complete division, as of other injuries of nerves, vary considerably in different individuals, according to peculiarity of diathesis, or even in the same individual at different times, according to the state of the general health, and other accidental circumstances. In a healthy person, when the external wound heals kindly by the first intention, no remarkable pain or unusual consequences are experienced. Both portions of the divided nerve retract a little, and their extremities, especially the upper one, enlarge and become more vascular, while coagulable lymph exudes around and between them. In a short time this exudation becomes gradually firmer, and is found to contain cells and nuclei, and then fine nerve-fibres, arising from the extremity of the central portion of the nerve advancing towards that of the peripheral portion, which, on being separated from its nervous centre, undergoes a gradual but rapid atrophy or degeneration. These newly-formed fibres are finer and greyer than those of the central portion of the divided nerve, and it is not till after a period of some months that they become fully developed. According to Ranvier, these fine new fibres descend into the sheaths of the peripheral or atrophied portion of the nerve; but it is a long time before these fibres acquire the normal size and appearance. The same kind of reparative process takes place when a portion of a nerve has been excised, only it occupies a longer period.

[1] Béclard, apud Descot, *Affections locales des Nerfs*, p. 41.

[2] Flaubert, 'Mémoire sur plusieurs cas de Luxation, etc.'; *Répert. gén. d'Anat. et de Phys. pathologiques*, 1827, vol. iii. part i. p. 102.

[3] Series viii. No. 131.

[4] *Military Surgery*, p. 191.

When the external wound, instead of healing kindly by the first intention, becomes irritable and inflamed, the ends of the divided nerve participate in the inflammation, and give rise to violent pain, spasmodic contraction of muscles, and other severe symptoms. This is what sometimes occurs after amputation when the stump inflames.

Mr. Langstaff has related an exceedingly interesting and instructive case of this description.[1] After amputation at the forearm in a female, the stump did not unite favourably, and she suffered the most distressing agony, which so affected her health, that she became extremely nervous. 'There was a constant state of convulsive action of the muscles of the stump. Everything that could be done to improve her health and relieve pain was fairly tried for several months, without the least good effect. Believing that a second operation was requisite, Mr Langstaff removed the arm above the elbow-joint, and previous to securing the arteries, drew out each nerve to the extent of half an inch from the surface of the stump, and cut through them to prevent their interrupting the progress of cicatrisation of the integumental parts. The patient was relieved of all her painful sensations, a good stump was made, and her health improved. On examining the amputated part, the median, radial, and ulnar nerves were found remarkably large. The extremities of the two latter were greatly increased by deposition of organised lymph.

Sometimes, after the complete cicatrisation of the external wound by which a nerve has been divided, the cicatrix becomes inflamed, and the nerve participating in the inflammation may give rise to the most acute pain, particularly when the part to which it belongs is put in motion. In other cases one or both ends of the divided nerve may be involved in the cicatrix and be the cause of most severe suffering. The position of the cicatrix is sometimes important, as when it happens to cross at a right angle the tract of a large nerve which is so related to it as in certain positions of the limb to be pressed against it, causing pain and even loss of motion.

Incomplete division of nerves is, in general, productive of much severer consequences than when the division is complete. If nearly the whole thickness of the nerve be divided, the free portions will retract and put the undivided portion on the stretch; but except in peculiar constitutions, under unfavourable conditions, or when the nerve becomes inflamed, this tension does not in general appear to give rise to serious results, as shown by many cases, among which one of Sir Astley Cooper.[2] But partial division of nerves occurring in persons of a peculiarly nervous, irritable, or hysterical constitution, is frequently a cause of the most distressing local and general symptoms.

Punctures made with different kinds of pointed instruments are the most common instances of this species of injury to nerves. The first symptom which ensues is generally acute pain at the injured part, coming on most frequently at the time of the accident, and darting along the course of the nerves either towards their peripheral extremities or in the opposite direction towards the spinal cord and brain. It is sometimes periodical in its attacks, and attended with redness, tingling, or more or less numbness and swelling of the part. Contractions of the limb, violent spasms or tremors of the muscles, trismus, and even epileptiform convulsions, are not uncommon, and in females hysterical excitement is a frequent consequence. After a time if the symptoms continue severe, the spirits become depressed, there is more or less prostration of strength, and, in some cases, delirium and coma supervene. The pain is often reflected on to other nerves with which the injured nerve is connected only through the nervous centres, and this sympathetic influence is sometimes experienced to a surprising and terrible extent.

Mr. Wardrop has related the case of a woman who pricked the forefinger of her right hand, near the point, with a gooseberry thorn. The wound was immediately followed by great pain, swelling and redness, which in a few days extended along the forefinger and adjoining phalanx of the middle finger. At the end of three months the pain and swelling disappeared, except from the two first phalanges of the wounded finger, which remained extremely painful. The patient's general health suffered considerably, and she had severe nervous paroxysms two or three times a day, during which the pain extended along the finger

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[1] *Medico-Chirurg. Trans.* vol. xvi. p. 140. [2] *Lectures by Tyrrell,* vol. iii. p. 171.

to the back of the hand, and between the two bones of the forearm, darted through the elbow-joint, and up the back of the arm to the neck and head, producing a sensation at the roots of the hairs as if they had become erect. To these symptoms succeeded dimness of sight, and subsequently the pain extended to the stomach, producing nausea and vomiting. She had constantly the feeling of a lump in her stomach, and vomited after taking food or drink. At the end of seven months, three incisions were made at the point of the finger, but they gave her no relief. She was afterwards completely cured by amputation of the finger.[1]

A case in which the most violent effects arose from the puncture of a nerve during the operation of bleeding, was related to Mr. Swan by Dr. Wilson of Grantham. The patient, who was a woman, had been bled by a gardener. On the second day she fell into strong convulsions, and some time after became comatose. The median vein in which she was bled had not healed, and was somewhat inflamed. An incision was made just above the orifice of the vein, when the patient immediately cried out, 'I am well; I can stir my arm.'

Even fatal effects occasionally follow the puncture of a nerve during the operation of bleeding. Such a case is recorded by Bonetus.[2]

Incised wounds of nerves are frequently the cause of the same kind of symptoms as those produced by puncture.

Hamilton relates the interesting case of a girl, aged seventeen, and of nervous temperament, who, while cutting bread, wounded the septum between the thumb and forefinger of the left hand. The pain from the first was very severe, became still more so, and extended to the thumb, forefinger, back of the hand, up the forearm, inside of the arm to the axilla, shoulder, and side of the neck. These and other symptoms continued for nearly three months after the external wound had healed, when she got a fright in the street, and fell into an hysterical fit. After two days of hysterical symptoms, all pain and swelling left the arm and never returned.[3]

This case is a good illustration of the remarkable influence of hysteria in aggravating the effects of local injuries, and affords an example of the singular manner in which these effects are removed by sudden emotions of the mind. Sir B. Brodie, who paid so much attention to this important subject,[4] justly observes, that when the patients are subject to hysterical paroxysms, sometimes the paroxysms cease on the appearance of the local symptoms, and sometimes, on the contrary, a recurrence of the former is followed by an abatement of the latter, or by complete recovery from them.

He mentions the case of a young lady, who having long suffered from hysterical neuralgia of the hip-joint and thigh, was entirely cured of all her symptoms on being thrown from a donkey.

I knew the case of a girl, who, while suffering from complete hysterical paraplegia, jumped up in a fright, on seeing a mouse run across the room, and was cured from that moment.

For an important case of incised injury of nerves, of which the following is the substance, we are again indebted to Mr. Wardrop.[5] A young gentleman cut the distal phalanx of the left thumb obliquely across the radial side with a gun-flint. The wound readily healed, but on the patient living freely, in a few days the thumb became painful, and although no change in its appearance could be perceived, and the cicatrix seemed perfectly natural, the pain extended to the forefinger, the radial side of the middle finger, and up the arm as far as the neck and side. The pulse was frequent and tense, the face flushed, and the tongue white and frothy. Copious general bleeding gave almost immediate relief. The symptoms, however, returned and yielded to another bleeding, with copious purging. The paroxysms of pain were several times distinctly produced by mental excitement, and on some occasions were brought on by taking even a small portion of animal food. The wounded thumb, which was at all times painful and extremely tender to the touch, was sometimes seized with paroxysms of agonising pain, which was no longer confined to those fingers supplied by the radial nerve, but extended over the whole hand, arm, neck, and even down the back. Mr. Wardrop divided the injured nerve, with complete abatement of all the symptoms. The success, however, was not permanent, for during several weeks after the operation, whenever he took food of difficult digestion, when purgatives did not readily operate, or when his mind was at all excited, the pain attacked his hand and arm, sometimes severely. After that time he completely recovered. The point of the thumb, however, always remained numb; but whenever the patient's stomach was disordered, he felt pain in the thumb.

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[1] *Medico-Chirurg. Trans.* vol. viii. p. 246. Sir B. Brodie has described a case of the same kind, occurring in a young lady eleven or twelve years of age (*Works*, vol. iii. p. 170).

[2] *Sepulchretum*, tom. ii.

[3] *Dub. Med. Journ.* vol. xiii. case iii. p. 42.

[4] 'On Local Nervous Affections, and Local Hysterical Affections,' *Works*, vol. iii. p. 133 *et seq.*

[5] *Medico-Chirurg. Trans.* vol. xii. p. 205.

This interesting case has several points worthy of particular observation. It affords a good example of acute inflammation excited in a recently injured nerve by a too early use of the part which it supplies, by an incautious mode of living, or by mental excitement. We also see not only that the pain—or rather the irritation exciting the pain—was reflected from the injured nerve to other and even distant nerves with which it is connected only through the medium of the nervous centres, but that even after the connection of the injured portion of the nerve with its nervous centres had been interrupted, pain was still excited in the other nerves by accidental causes. Indeed, in very severe or long-standing cases of traumatic neuralgia, there is reason to believe that the nervous centres in which the injured nerves are implanted, are sometimes secondarily and permanently deranged or diseased, and in this way become the source not only of neuralgia, but even of paralysis in other and distant parts. This view, entertained by the two writers of this article, is also held by Vulpian, Hayem, and other observers. Among other cases that might be mentioned, one important case of complete division of a nerve, recorded by Mr. Swan, is in harmony with this view.

A young lady, aged twenty-three, on December 20, 1822, wounded the ulnar side of the second finger of the left hand, near the middle of the second phalanx, while cutting an orange. The pain extended to the centre of the left breast, and up the left side of the neck to the face, along the branches of the facial portion of the seventh (?) nerve. On the sixth day after the accident the wound had entirely healed, but was extremely tender. The pain was excruciating when she attempted to move the arm with the hand in a state of pronation. Whenever she read, pain was produced in the superciliary nerves of the last side, after about five minutes. As the patient's health was suffering, on January 11, 1823, Mr. Swan divided the digital nerve near the middle of the first phalanx. She was immediately and completely relieved, and could move her arm in any direction without pain; but as the effects of the operation were not permanent, on March 5 the finger was amputated at the joint between the metacarpal bone and the first phalanx, and on examining it at the original wound, a small fibril of the digital nerve was found divided; the end of this next the tip was found incorporated with the cicatrix; the other was formed into a small bulb. At the place of the division of the nerve at the first operation, both its extremities were incorporated with the cicatrix, as with those of the dorsal branch, which had also been divided. Although her local and general symptoms were much relieved by the operation, she continued to feel pain in the hand, arm, neck and face, and about four months later (in July), she began to complain of her spine. About the end of November she complained very much of pain in her back, with tingling in her arms, and a difficulty of supporting herself erect. Percussion along the spine produced uneasiness in every part, and much pain about the lower dorsal vertebræ. Some time after, she was seized with violent pain in the left knee, which lasted for two or three days. Pressure on each side of the spinous processes of several of the vertebræ produced pain, and percussion with a key made it very severe. She had difficulty in voiding her urine. In October 1824, she complained of numbness and loss of sensation in the left hip and shoulder, and of pain at the back of the neck, with a feeling as if the neck could not support the head. At the latter end of the year 1825, and beginning of 1826, she was affected by dizziness, in fits of which she fell down, but never entirely lost her consciousness. Her left arm and leg were weaker than the right. When the membrane lining the left external auditory meatus was touched, cough was produced. Up to March 1829, she had varying degrees of pain and weakness, soreness in the throat with an appearance of venous congestion, and disorder of the digestive organs, with great tenderness in a spot about the size of half-a-crown at the pit of the stomach. She had also some pain and swelling about the uterus and vagina. When sleeping on her left side she very frequently awoke with pain in the amputated finger. Tic-douloureux was brought on by either exciting or depressing emotions, by exposure to strong light, and by fits of sneezing, with which she was frequently troubled. When Mr. Swan last saw her on October 30, 1833, she was nearly in the same state as she had been in for a long time; but we are left in ignorance of the subsequent course of the disease. The patient's father had a paralytic attack.[1]

Here, then, we have an instance of very extensive neuralgia, of incomplete but extensive paralysis, and other severe symptoms, extending through a period of ten years, as the effects of simple division of a nerve of one of the fingers. That these morbid symptoms arose out of some peculiarity of constitution, there can be no doubt; and it seems highly probable that this peculiarity was of an hysterical character.

[1] Swan, *Diseases, &c. of Nerves*, 2nd edit. p. 129. Of this remarkable case we have given the briefest possible abstract of the most salient and important points, but the details, which are very full, deserve attention.

The symptoms of the various kinds of injuries of nerves due to a wound have been classified in the following manner by Weir Mitchell :—

- Early symptoms
  - Defects of mobility
    - From local or general shock.
    - From direct nerve wound.
  - Defects of sensibility
    - From shock.
    - From direct nerve wound.
- Later symptoms
  - Alterations of mobility due to
    - Tonic spasm.
    - Tremor.
    - Paralysis.
    - Joint diseases.
    - Nutritive affections of muscles.
  - Alterations in sensibility
    - Anæsthesia.
    - Analgesia.
    - Hyperæsthesia.
    - Causalgia (burning pain).
    - Neuralgia.
- Remote nutritive changes
  - Atrophic change in the skin and its appendages, and in the muscles; eczema; subacute inflammation of joints causing stiffness and subluxations; muscular contractions; altered secretions.

Foreign bodies embedded in a nerve or pressing against it are often the exciting cause of violent pains and other symptoms similar to those which result from wounds.

Jeffries relates the case of a girl who suffered from violent and almost continual neuralgia of the face for fourteen years. A hard, pointed substance was felt under the skin of the right cheek, and at this point the slightest touch brought on an attack of pain. An incision was made, and a triangular piece of a china cup removed, with complete cessation of the neuralgia.

One of the most interesting and remarkable cases of this description is related by Denmark.[1] A young soldier was wounded by a musket-ball which entered the triceps extensor cubiti, and passed out anteriorly through the bend of the arm. The wound soon healed. The man was subsequently admitted into Haslar Hospital, with excessive pain, frightful dreams and startings. The forearm was always bent and in the supine posture. The pain began at the extremities of the thumb, and all the fingers except the little one, and extended up the arm to the part wounded. It was a burning pain, and so violent as to cause a continual perspiration from the face. At his own request, the arm was amputated, with immediate relief, and he was discharged cured in three weeks. On examining the amputated arm, the radial nerve seemed to be blended with, and intimately attached to, the wounded parts, for the space of an inch. It had itself been wounded, and at the place of the injury, was thickened to twice its natural diameter, and seemed as if contracted in its length. On further examination, Dr. Denmark was surprised to find, in dividing the fibres on the posterior part of the wounded nerve, that there was a small portion of the ball firmly embedded in it, which had been driven off by grazing the bone.

It is well to remark about the above case (Denmark's) that there were no convulsions except in the arms, although there were most intense pains. It is a wrong idea that wounds of nerves give rise to general convulsions on account of the pain they inflict. In many other cases, with considerably less pain, there has been general convulsions.

Treatment of injuries of nerves.—When an incised or other open wound is accompanied and followed by very acute pain, by more or less numbness, and by partial or complete loss of sensation and motion in the part beyond the wound, we may conclude that a nerve has been either injured or divided. Under these circumstances it is of primary importance to remove all dirt or other foreign bodies that may be present, to promote healing by the first intention, and enjoin perfect rest. If these precautions are not adopted and the external wound inflames, the nerve is liable to

[1] *Med.-Chirurg. Trans.* vol. iv. p. 48.

participate in the inflammation, and may then become the source of the violent and distressing symptoms already described. When this is the case, it may be necessary to apply leeches to the neighbourhood of the wound, to use either cold lotions or warm fomentations of poppies, and poultices, and to act briskly on the bowels by means of purgatives. When the inflammatory symptoms run high and the constitutional disturbance is considerable, the most decided benefit can be derived from a combination of tartarated antimony, opium, and hyoscyamus, given at short intervals, the antimony being in sufficient quantity to keep up a state of great nausea.

In some cases, after all inflammatory action has subsided and the external wound has completely healed, painful and distressing symptoms may still persist at intervals for a very considerable period; and in other cases where the external wound has healed at once in the kindliest manner by the first intention, similar symptoms may supervene. Most of these latter cases are females of a more or less hysterical constitution. But, as we have already seen, there are other causes besides hysteria, such as pressure, dragging, or inflammation of a cicatrix; a premature use of the limb—that is, before the nerve is sufficiently repaired or united; and while the nerve is in this state, it is in some cases very susceptible of irritation by errors in diet, intemperate habits, mental emotions and influences of the most trivial nature. One part of the treatment will of course consist in avoiding or removing the exciting cause, if this can be ascertained. When the cicatrix presses on the nerve, active frictions with moderate exercise of the part will relieve the pain. If it be simply painful or tender, the application of belladonna will frequently allay the irritation; or if it appears to be inflamed, the removal of a little blood by means of two or three leeches may be necessary. If pain and tenderness be experienced in the course of the nerve, blistering, repeated frictions with a piece of ice, or superficial applications of the actual cautery, will afford relief. In cases of that intense *burning* pain (W. Mitchell's *Causalgia*), which is sometimes so agonising, the last of those three means is by far the best. The painful state of the parts to which the wounded nerve is distributed may be treated by the local application of anodynes, such as chloroform, aconite, opium, and belladonna; but the most effectual mode of using most anodynes is by subcutaneous injection, and the best substances to employ in that way are atropia and morphia. Long ago one of the writers (Dr. B.-S.) has used in such cases, and in many others, a solution of those two alkaloids together (from $\frac{1}{40}$ to $\frac{1}{60}$th of a grain of atropia, with $\frac{1}{3}$ to $\frac{1}{2}$ of a grain of morphia). Mr. Pearson [1] has recorded a very remarkable case of neuralgia, which, after resisting every kind of treatment, yielded at length to the application of a stimulating embrocation that was rubbed into the part for ten minutes twice or three times a day.[2] In some instances when every other remedy has failed, the happiest effects have resulted from the use of mercury exhibited for a period sufficiently long to affect the gums. Mr. Hamilton has recorded two cases of this description.[3] In many instances, however, in which this remedy has been employed, it has completely failed. Another most valuable means of treatment consists in applications of a *descending* constant current of a powerful galvanic machine.

In extreme cases, when all other resources are exhausted, it becomes a question whether a portion of the nerve should be excised, or whether the member which it supplies should be amputated. If the constitutional disturbance be of an alarming character, there should be no hesitation in at once excising at least a small portion of the nerve; for these operations have been frequently followed by an immediate arrest of all the symptoms, as in a case of Dr. Wilson's.

In a case of contused thumb followed by violent symptoms, Sir Astley Cooper removed five-eighths of an inch of the radial nerve with complete success. Mr. Sherwin relates the case of a servant-maid, who suffered from the most alarming symptoms after the operation of venesection. At the end of a fortnight she was cured by a deep incision above the

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[1] *Medico-Chirurg. Trans.* vol. viii. p. 252.
[2] ℞ Ol. olivæ, ℥ijss.; terebinth, ℥jss.; acid. sulph. ℥jss. M.
[3] *Dublin Medical Journal.* vol. xiii. pp. 41, 48.

cicatrix.[1] A similar case with the same result is recorded by Dr. Watson.[2] Mr. Earle excised about half an inch of the radial nerve, for punctured wound of the thumb followed by pain, spasm, temporary trismus, &c., which had lasted for two months. The patient was soon relieved, and after some months completely cured.

In many instances in which division of the nerve has failed, amputation has been performed with complete success, as in a case of Mr. Wardrop.[3] A still more decided example is recorded by Mr. George Bell.[4] A lady, twenty-six years of age, while cutting a loaf of bread, injured the nerve of the thumb, on the radial side. The wound healed kindly, but was followed by excruciating pain and other violent symptoms. Two years after, on two different occasions, an incision was made through the soft parts to the bone, in the neighbourhood of the wound, but with only temporary relief. Mr. Bell removed the thumb at the second joint, and in five or six weeks she was restored to perfect health.

However, in some cases, especially of females of marked hysterical constitution, neither the division of nerves nor amputation is of any permanent benefit; while in others which have resisted every kind of treatment except by operation, a spontaneous cure has occasionally been effected.

When nerves have been contused or compressed, without becoming inflamed, the best kind of treatment consists of the repeated use of exceedingly hot fomentations, frictions with stimulating embrocations, and Faradisation. But, if tenderness and pain be felt in the course of the injured portion of the nerve, it will be necessary to apply leeches, cold lotions, and blisters, and to insist on perfect rest.

Nutritive and other Changes resulting from Injuries and Diseases of Nerves.

(1) *Changes due to Injuries of Nerves.*

In the earlier part of the present century a few observers occasionally and incidentally noticed the morbid effects of injuries of nerves on the nutrition of certain tissues; but it is only within the last twenty years that the subject has been systematically studied. These lesions of nutrition consist chiefly of—

(*a*) Diminution of temperature in the parts to which the injured nerve is distributed.

(*b*) Cutaneous eruptions, ulcerations, and alterations in the colour and texture of the skin, and its appendages.

(*c*) Increase or diminution, and alterations in the quality, of the secretions of the skin.

(*d*) Various alterations of joints and of bones.

(*e*) Atrophy and contraction of muscles supplied by the injured nerve.

(*a*) The effects of injuries of nerves and of nerve-centres on the temperature of paralysed parts was well investigated in the early part of this century by several English observers, particularly by Earle and Yelloly.

Earle excised a portion of the ulnar nerve of a girl for severe neuralgia, and five years after he found the temperature of the paralysed parts decidedly diminished. He also found that they were unable to resist the injurious effects of cold. Frosty weather produced blistering and ulceration of the little finger. Yelloly mentions a case of anæsthesia, in which similar effects were produced by warmth.

Mr. Jonathan Hutchinson, in a valuable and interesting article on 'Injuries to Nerve-trunks,' observes that the parts paralysed by division of the nerve which supplied them, could never, even in the warmest temperature, be raised to that of adjacent, unparalysed parts. 'Nor does even the existence of active inflammation raise the part to the normal standard, although it much increases it.' 'It would appear, therefore, that while a paralysed part can be cooled to almost any extent, it

[1] Duncan's *Medical Commentaries*, vol. iv.
[2] *Medical Communications*, vol. ii. p. 251.
[3] *Medico-Chirurg. Trans.* vol. viii. p. 246.
[4] *Edinburgh Journal of Medical Science.*

cannot be raised by artificial heat beyond a certain point, and that point much below the maximum of its uninjured counterpart.' One of the writers (Dr. B.-S.) has published a case showing that even twenty years after an injury to a nerve, the temperature of the parts to which it is distributed may remain permanently diminished.[1]

(*b*) Romberg, more than thirty years ago, very clearly described some of the most important nutritive changes that the skin and its appendages undergo, in certain cases of nerve-lesions. He attributed these changes to the cessation of proper supply of nerve influence. This view has been contested by one of the writers (Dr. B.-S.), who has tried to show that the mere cessation of nerve action is not sufficient to produce any of the various alterations of nutrition of the skin which are observed in cases of nerve injuries. He has shown that some irritation of incompletely divided nerves, acting in a direct centrifugal way or by a reflex action, is the great cause of nutritive and secretory changes after nerve wounds. Professor Charcot agrees with him almost entirely on those points, and we cannot do better than refer the reader to the elaborate discussion of this great physiological and pathological question, which will be found in the first volume of lectures of that able physician.[2] The following facts show the variety of nutritive changes produced by an injury to nerves.

Romberg mentions a case of Dieffenbach's, in which there had been violent pain for ten years in the right foot. On the outer and posterior side of the thigh, near its middle, there was a tumour about five inches in circumference, which was also painful, and, when pressed, augmented the pain in the foot. The tumour was removed, and Romberg saw the patient two weeks after. There was complete anæsthesia in the part supplied by the peronæus and tibialis nerves. The muscles of the leg and foot were paralysed. Ulceration appeared early in the heel. Soon after, the nails exfoliated. At the end of three years, Romberg saw the patient again. She rested on the external edge of the right foot, which thus presented the appearance of varus. Further ulceration ensued, with necrosed bone, and desquamation of the epidermis, like psoriasis, the colour of the skin being dark red and shining.[3] Hamilton relates a case of Mr. Crampton's, in which puncture of the musculo-cutaneous nerve during the operation of blood-letting was followed by the most severe neuralgia and other symptoms, and the wounded arm became *covered with hair*.[4] Larrey mentions the case of a soldier who received a kick from a horse over the right eyebrow. The frontal sinus was fractured, and after some days, cutaneous hyperæsthesia and tetanic symptoms of the same side supervened. To Larrey's great surprise, the hair and moustaches of the injured side bristled up and became exquisitely tender to the slightest touch. About a year later the nails became ragged and rough, and fell off.[5] Similar effects were observed by Bellingeri from a contused wound above the supra-orbital foramen. The hair on the injured side not only became stiffer, but grew with much greater rapidity.[6] Pouteau records a remarkably interesting case, with symptoms similar to those of Larrey and Bellingeri, and resulting from a contused wound of the supra-orbital nerve.[7] In a young lady, who came to Dr. L. Clarke with protracted neuralgia of a circumscribed portion of the scalp, the hair over the painful part was not only coarser and stiffer, but perfectly white. Reading, or playing the piano for a few minutes only, brought on the most insupportable and indescribable feelings, radiating as it were from the affected part. In a case of temporal neuralgia mentioned by Trousseau, the hair on the affected side turned white, and acquired considerable stiffness in a very short time.

With regard to cutaneous eruptions resulting from injuries of nerves, numerous interesting observations, besides the one already quoted from Romberg, have been recorded by Rayer,[8] Earle,[9] Rouget,[10] Oppolzer,[11] Charcot,[12] Raynaud,[13] Kuhl,[14] Thomas,[15]

[1] *The American Archives of Scientific and Practical Medicine*, New York, 1873, p. 58.
[2] *Lectures on the Diseases of the Nervous System.* Translated by Dr. Sigerson, and published by the Sydenham Society, London, 1877.
[3] Romberg, *Nervous Diseases of Man*, vol. i. p. 205.
[4] *Dublin Med. Journal*, 1838, vol. xiii. p. 46.
[5] *Clin. Chirurg.* tome i. p. 200.
[6] *Archiv. gén. de Méd.* 1835, tome vii.
[7] *Œuvres posthumes*, tome ii. p. 92, obs. iii.
[8] *Traité des Maladies de la Peau*, 1822, tome ii.
[9] *Medico-Chirurg. Trans.* vol. vii.
[10] *Journal de Physiologie*, 1859.
[11] *Allgemeine Wiener medicinische Zeitung*, No. 48, Nov. 1866.
[12] *Journal de Physiologie*, 1859, and *Archives de Physiol.*, 1868.
[13] *Thèse de Paris*, 1862.
[14] Apud Samuel, *Die trophischen Nerven*, p. 189.
[15] *Archiv der Heilkunde*, 1866, p. 153.

Paget,[1] Brodie,[2] Butruille,[3] Mayet,[4] Leloir,[5] and others. These cutaneous affections have been shown to consist chiefly of erythema, and of vesicular eruptions allied to eczema, erysipelas, and herpes. Sir James Paget has given an excellent description of the erythema observed in cases of injured nerves. 'In well-marked cases,' he says, 'the fingers which are affected are usually tapering, smooth, hairless, almost void of wrinkles, glossy, pink or ruddy, or blotched, as if with permanent chilblains. They are commonly also very painful, especially on motion, and pain often extends from them up the arm.' We will refer for this part of our subject, as also for any kind of alteration due to the nervous system, to the admirable dissertation of Dr. X. Arnozan.[6]

It is to Drs. Mitchell, Morehouse, and Keen, of the United States, that we owe the most precise account of the different morbid changes in the skin, and other tissues, resulting from particular injuries of nerves.[7] They have shown that the changes in the skin which follow wounds of nerve-trunks are of two kinds. The first is the result of *entire* division of the nerves of the part, with palsy of the whole limb. In most instances there is early œdema of the part. The skin thickens and dries; the epithelium hangs in patches here and there, and is yellow and even pale-brown. These peculiarities, however, are partly the consequence of mere disuse. But the nails become curved as in tubercular disease.

The second kind of pathological change is the result of only partial division of the nerve. The skin is deep red or mottled, or red and pale in patches. The cuticle seems partially lost, so that the cutis is exposed in places. The subcuticular tissues are nearly always shrunken. The surface of all the affected parts is glossy, generally devoid of wrinkles, and perfectly free from hair. Sometimes the fingers are dotted with islets of thin and red and glossy skin. This glossy appearance of the skin is always accompanied by pain, generally of a burning character.[8] 'No particular time can be named as the period at which these changes in nutrition first show themselves. This alone can be said, that they do not belong to cases of complete destruction of the nerves. They may begin within a few days, or at any later date; but usually they arise while the wound is healing.'

If the nerves of the hand be injured, the hair, after some months, disappears from the affected fingers, and the nails undergo remarkable alterations. These alterations consist of a curve in their long axes, an extreme lateral arching, and sometimes a thickening of the cutis beneath their extremities. In other instances the skin at that end of the nail next the third finger-joint becomes retracted, leaving the sensitive matrix partly exposed. At the same time the upper line of union of skin and nail retracts into or under the latter part, and in place of a smooth edge is seen through the nail as a ragged and notched border. 'No deformity of the nails in tubercle at all approaches that which nerve-wounds occasion. Indeed, we think it would be possible for one familiar with these cases to diagnose the existence of nerve-lesion from the form of these protuberant and oddly-curved nails.' When the nails of the toes have been attacked, the curving is as marked, but a distressing ulceration is apt to occur at their angles, and to break out again and again. The best remedy then is excision of the outer edge of the nail, matrix and all.[9]

In a case mentioned by Mr. Jonathan Hutchinson of division of the ulnar nerve, the nail of the little finger, about two months after the accident, came off together with the skin, 'like the end of a glove.' It grew again, but not to more than half its original size.[10] A similar case has been published by Dr. Hayem.[11]

Among the morbid effects following a nerve-lesion one of the most frequent

[1] *Medical Times and Gazette*, 1864.
[2] *Works*, vol. iii. 'Local Nervous Affections.' [3] *Du mal perforant.* Thèse. Paris, 1878.
[4] Mayet, *Gazette médicale de Lyon*, 1868.
[5] Leloir, *Comptes rendus de la Soc. de Biologie.* Février, 1880.
[6] Arnozan, *Des lésions trophiques consécutives aux maladies du système nerveux.* Paris, 1880.
[7] *Gunshot Wounds and other Injuries of Nerves.* Philadelphia, 1864. [8] Page 80.
[9] Page 82. [10] *London Hospital Reports*, vol. iii. p. 308.
[11] Hayem, *Archives de Physiol.* No. 2, 1878.

is œdema. The experiments of Ranvier, of Boddaërt, and of one of the writers (Dr. B.-S.), have shown how great is the share of a vaso-motor paralysis in such cases.[1]

Another important effect of nerve-lesion is the production of an ulcer or of a slough. One of the writers (Dr. B.-S.) has maintained that such alterations are effects of considerable irritation of the nervous centres or of nerves, and cannot be the result of a mere vaso-motor paralysis.

(*c*) *Alteration of secretions after injury of nerves.*—We have already seen that after the nerves of a limb have been completely divided, the skin is generally dry; but injuries of nerves without complete section modify the secretions in regard both to quality and quantity. The secretion is generally abundant, and sometimes intensely acid, so that an odour like vinegar can be smelt in the neighbourhood of the patient. In one instance the odour of the sweat was 'disgustingly heavy,' and resembled the smell from a bad drain.[2]

(*d*) *Various alterations of joints and of bones.*—In the second edition of this work one of the writers (Dr. L. C.) called attention to a peculiar affection, particularly interesting to surgeons, and consisting chiefly in a periodical swelling of joints, the result of both idiopathic neuritis and traumatic affections of nerves. It so closely resembles ordinary rheumatism or gout that it is not easy to point out the distinguishing characters of the two kinds of disease. Remak calls it *arthritis spuria.*[3] Dr. J. K. Mitchell has recorded some very interesting cases of this affection, in the *American Journal of the Medical Sciences* (1831, vol. viii.). It may occur at any time after the first few days of injury to a nerve, and may attack any articulation, or all the articulations of a member. Once fully established, it keeps the joints stiff and sore for weeks or months. When the acute stage is past, the tissues about the articulations become hard, and partial anchylosis results. Of all the agencies which impede movement, it is the most difficult to relieve.

Since the researches of Moritz Schiff, according to which bones in paralysed parts become atrophied only from rest, while, on the contrary, they become larger, *i.e.* hypertrophied from the effect of a vaso-motor paralysis, many clinical facts have shown that an atrophy of bone may be due to an irritation of nerves, and that hypertrophy does not always result from a vaso-motor paralysis. We will refer to the papers of Avezou, Bouchut, Virchow, Henrot, Weir Mitchell, and others, quoted by Arnozan,[4] and Dr. J. W. Ogle.[5]

(*e*) *Atrophy and contraction of muscles from injury of nerves* has been carefully investigated by Dr. Duchenne, de Boulogne. There is always in man, after a time, at least some atrophy of the various muscles to which is distributed a divided nerve. In animals it is not constantly so, as one of the writers (Dr. B.-S.) found long ago, as in one case of extirpation and no reproduction of the facial nerve there was no trace of muscular atrophy in the facial muscles. The difference lies probably in this fact, that the facial nerve in some animals does not contain the vaso-motor nerve-fibres of the facial muscles, while in man the motor and the vaso-motor nerves are in the same trunk. There is no question that in *partial* division or injury of a nerve, there is usually much more rapid atrophy of muscles than after a complete section. Then a whole group of muscles may be affected, or only part of a group; a single muscle only, or even only part of a muscle, which, moreover, may be affected in either a lateral or a longitudinal direction. So soon as the muscular fibres begin to suffer in nutrition, their tension or tonicity diminishes; they become softer, more flabby or relaxed. Sooner or later they begin to waste, and after a time, in many instances, they acquire a kind of morbid tension, and contract or shorten permanently to a greater or less extent, causing a variety of deformities, alterations in the form of the joints, and loss of natural movement. This morbid tension, however, is not always in proportion to the degree of atrophy, for in some instances the wasting is slight

[1] Arnozan, *loc. cit.* p. 115. [2] Mitchell, Morehouse, and Keen, *op. cit.* p. 86.
[3] *Allg. med. cent. Zeitung*, Berlin, 1863. 'Ueber den Einfluss des Nerven-systems auf Krankheiten der Knochen und der Gelenken.'
[4] *Loc. cit.* p. 97. [5] *St. George's Hospital Reports*, 1871.

while the muscular contraction is extreme. Moreover, a muscle may become shortened from paralysis of its opponent, and this condition must be distinguished from the shortening which is due to atrophy.

Early loss of tone in a muscle, from injury of its nerves, is a bad sign. Rapid diminution of size and contraction, when due to nutritive changes, is still worse. All these changes are ominous of ultimate deformities and permanent loss of power.[1] In the diagnosis and prognosis, no less than in the treatment of injuries to nerves and their consequences, electricity plays a most important part; and for its first application to these purposes, we are chiefly indebted to Dr. Duchenne (de Boulogne). The property of contracting under the influence of electricity he calls electro-muscular contractility. Duchenne has laid down as a law that the persistence of this property is not necessary for the exercise of *voluntary* movements.[2] In the last edition of his great work (1872, p. 372), however, he says that the electro-muscular contractility always returns soon in paralysed muscles recovering the power to act under the stimulation of the will. On the other hand, muscles that are partially or completely paralysed, with regard to the *will*, may sometimes retain their normal degree of electro-muscular contractility; while in certain cases, muscles which have lost, to a very unequal degree, the power of contracting under the stimulus of electricity, may seem to be all equally paralysed as regards the *will*. There is another remarkable and important practical point to be remembered, viz., that although the retention of electro-muscular contractility is not absolutely necessary for the exercise of voluntary contraction, yet that whenever it is lost, or even impaired, the prognosis is unfavourable in reference to the return of *voluntary* control, and indicates that the affected muscles will suffer in their nutrition and become atrophied. It is curious, however, and very important, that notwithstanding the loss of electro-muscular contractility, the *therapeutical* power of Faradisation may still exercise its influence on the paralysed muscles.

Different forms of paralysis which depend on traumatic affections of nerves, and which may appear to be exactly alike—which cannot, indeed, be distinguished from each other by the ordinary modes of diagnosis—may nevertheless differ essentially from each other with regard to their progress, their gravity, or their termination. The electro-muscular test alone enables us to discriminate those cases in which muscles will remain paralysed and become atrophied in the course of a few months, from other cases in which it may be predicted with certainty that the paralysis, without atrophy of the muscles, will disappear, either spontaneously or by means of Faradisation.

In paralysis resulting from *cerebral* disease, the electro-muscular contractility usually remains unaffected, and therefore Faradisation is of great importance in the differential diagnosis of paralysis which follows injuries of nerves or affections of the spinal cord.

Treatment.—For restoring the paralysed and wasted muscles to their original condition, electricity is unquestionably the most important agent. It should be employed daily for at least ten or fifteen minutes, and each muscle should be separately Faradised. The period when the treatment by electricity should commence must vary according to the peculiarities of the case. If the electro-muscular contractility remain intact, Faradisation should be employed as soon as possible. But when this property is lost—that is, when the nerve-influence is no longer supplied to the muscles, and more particularly when the muscular sensibility is impaired—the treatment by electricity is of no service, and should not be employed until some months after the injury, or until there is good reason to believe that the nerve-lesion is repaired. In addition to electricity, dry-cupping of a whole limb by *Junod's boot*, dry heat after applications of ice, frictions in the direction of the venous current, and shampooing should be employed, with passive motion, to be followed by frequent voluntary exercise of the muscles, as soon as voluntary control is in any degree restored. The douche is often of great service, particularly if hot and cold water be

[1] Mitchell, Morehouse, and Keen, *Gunshot Wounds*, 1864, p. 120.
[2] *De l'électrisation localisée*, 2me éd. Paris, 1861, p. 330.

alternately used. Care should be taken to preserve warmth in the affected part. When flexion or extension of a limb occurs in consequence of contracted muscles, splints, bandages, and other apparatus will be necessary. If there is the evidence of *neuritis*, a descending constant galvanic current, or the actual cautery, or both, should be used (see *ante*, TREATMENT OF NEURITIS).

When the effects of the nerve-lesion are aggravated or prolonged by some peculiar diathesis, or when the health of the patient is suffering from severe pain and want of sleep, general as well as local treatment must be adopted. Narcotics, iron and quinine, cod-liver oil, and phosphorus are the most worthy of recommendation. The hypodermic method is the best mode of administering narcotics. The combined use of morphia and atropia should be preferred to that of either of these alkaloids alone.

(2) *Changes due to Idiopathic Affections of Nerves.*

Although traumatic lesions of nerves give rise to the most serious nutritive changes in the tissues to which those nerves are distributed, it is not uncommon to find that idiopathic affections of nerves are followed by changes of a similar nature.

The principal alterations in the nutrition of the skin resulting from idiopathic neuritis and neuralgia are manifested in the form of herpetic eruptions. Rayer, we believe, was the first to point to neuralgia as the cause of these eruptions, while other writers, including even Valleix and Cazenave, regarded the neuralgia as a consequence of the cutaneous affection. Rayer's opinion, however, has been fully confirmed by subsequent observation. The pain is frequently found to precede the eruption, while the latter is sometimes seen to follow the course of the affected nerve.

Barensprung has recorded a very valuable case, to which we have already alluded, and which proves in the most convincing manner, the close relation between idiopathic inflammation of nerves and herpes zoster. The patient was a child one year old. The eruption extended round one side of the thorax from the sixth to the ninth rib, and after death, which resulted from tubercular disease, the roots of the sixth, seventh, and eighth intercostal nerves, but especially the seventh, were increased in size and of a red colour, in consequence of the presence of enlarged and tortuous vessels in the neurilemma. The diameter of the seventh intercostal exceeded by more than one-half that of the fifth or the ninth. The corresponding intervertebral ganglia were firmly adherent to the intervertebral canal; their connective tissue presented an inflammatory redness, and they were decidedly increased in size.[1]

MM. Charcot and Cotard have related the equally interesting case of a woman, aged seventy-eight, from whom a cancer of the right breast was removed in August 1865. In October of the same year, she complained of sharp pains in the right shoulder, and in the right half of the neck. These pains were continuous, but increased in the severity at intervals, during which the patient appeared to suffer the most acute pain. About December 15 of the same year an herpetic eruption made its appearance over the whole right half of the neck, limited exactly, both before and behind, to the median line. The eruption occupied all the other parts of the skin which are supplied by branches of the cervical plexus on the right side, but was not followed by any diminution of pain. The patient died on December 26, after symptoms of effusion into the pleura on both sides. On post-mortem examination it was found that while both the anterior and posterior roots of the spinal nerves in the cervical region were perfectly healthy, the intervertebral ganglia, as well as the compound tracks formed by the union of the two roots, presented a slight tumefaction, and a vascularity which was manifested by a bright red colour. The difference was striking when the corresponding parts on both sides were examined.[2]

Among the most remarkable cases of neuritis giving rise to herpetic eruptions of the skin are those which M. Leudet, of the Hôtel-Dieu of Rouen, has shown to be caused by the inhalation of carbonic acid.

When the symptoms of asphyxia have subsided, it is not uncommon, after a variable number of days, to find certain disorders both of sensibility and motion. The lower extremities are the parts which are usually affected, although different parts of the nervous system are sometimes involved. In one case, which proved fatal, M. Leudet found the right sciatic nerve at least one-third thicker than the left; its neurilemma was injected, thicker, and more indurated than on the opposite

[1] Barensprung, *Annal. Charitekrank. zu Berlin*, vol. xi. part ii. p. 96.
[2] *Mémoires de la Société de Biologie*, 1866, p. 41.

side. In these singular cases, the skin was affected by eruptions similar to herpes. These eruptions appeared almost immediately after the subsidence of the symptoms of asphyxia, and in general, lasted only a short time.[1]

Herpes is not the only cutaneous eruption that has been found to follow neuralgia and neuritis, whether traumatic or idiopathic: lichen has been observed by Canuet in cases of neuralgia;[2] acne and erysipelas have been seen by Hasse[3] and Romberg[4] to accompany the same affection. We will refer to the work of Arnozan (already quoted, p. 121 to 142) for a good many interesting cases of various kinds of skin alterations due to nerve-irritation.

J. Lockhart Clarke, M.D., 1870.
C. E. Brown-Séquard, M.D., 1882.

[1] 'Recherches sur les troubles des Nerfs périphériques, et surtout des Vasomoteurs, consécutifs à l'asphyxie par la vapeur de charbon.' *Archives de Médecine*, mai 1865.
[2] *Thèse de Paris*, 1855, p. 29. [3] *Nervenkrankheiten*, p. 62. [4] *Op. cit.*

DISEASES AND INJURIES OF NERVES.

PART II.

REMOTER CONSEQUENCES OF NERVE-LESIONS.

Introduction.

TWO distinct groups or classes of symptoms may be caused by a lesion of a nerve; in one class the symptoms are the effects of the *loss of function* or *cessation of action* of the nerve; in the other, on the contrary, they are produced by *an action* of the injured or irritated nerve. In the first class, therefore, the symptoms depend on *lack of action*, while in the second, they are due just to the reverse, *i.e. the existence of action*, in a nerve.

Each of these two classes of symptoms may be subdivided. As there are at least four different kinds of nerves, four distinct kinds of symptoms of loss of function or cessation of action may be observed after a lesion of a nerve:

1st. There may be paralysis of motion.

2nd. There may be paralysis of centripetal nerves (sensitive, incito-motor, &c.)

3rd. There may be paralysis of the vaso-motor nerve-fibres, in consequence of which blood-vessels may be distended and full of blood.

4th. There may be paralysis of those special nerve-fibres, which have the power of increasing the activity of nutrition and secretion.

Leaving aside these four kinds of symptoms, I will confine myself here to the study of some of the effects of irritation of nerves. These effects may be grouped under two heads—the *peripheric*, or *direct;* and the *remote, indirect*, or *reflex*. Of the peripheric, or direct effects, I will simply say that they give origin to the five following kinds of symptoms, which have been fully studied in the preceding article:

1st. Contraction of muscles.

2nd. Referred or subjective sensations (formication, pricking, feelings of pain, heat, cold, &c.)

3rd. Diminution in the quantity of blood, owing to the contraction of blood-vessels in the part where the injured nerve distributes its fibres.

4th. An increase in the quantity of blood when the irritated nerve-fibres are those having normally the power of increasing the interchange between the blood and the tissues.

5th. In consequence of one or the other, or a combination of the just mentioned kinds of changes in the circulation of blood, there are various alterations of nutrition or secretion in the eyes, the skin, the joints, &c.

Of these five kinds of effects of irritation of nerves, four, *viz.* the first, third, fourth, and fifth, may also be caused either by a genuine reflex action, or by some peculiar influence upon or through the nervous centres. I propose here to treat only of these four last kinds of symptoms.

All the functional affections or disorders, and most of the organic diseases, are frequently produced by an influence exerted upon the nervous centres by an irritation of any part of the length of a nerve. This irritation may occur in the ramifications of a nerve in a mucous membrane or the skin (and be due to worms, a calculus, &c., or to cold); or it may depend on an organic or a functional affection of the trunk of a nerve (as in cases of wounds, burns, tumours, or neuralgia). In most instances an

inflammation of the various viscera owes its origin to a reflex influence on the organ which becomes inflamed, proceeding from the irritation of some cutaneous nerve-fibres by a draught of cold air. I will not say more here on this reflex origin of visceral inflammation caused by cold acting on the skin, my object being only to give an outline of the various effects of injuries or diseases of all parts of nerves excepting the network of their terminal ramifications.

Of the various reflex and other remote effects of irritation of centripetal nerves, the following are the principal, of which I propose to speak successively: *epilepsy*, *tetanus*, *hysteria*, *catalepsy*, *chorea* and other *convulsive affections*, *trembling palsy*, *paralysis* of various kinds (*local paralysis*, *hemiplegia*, &c.), *anæsthesia*, *deafness*, *collapse*, *insanity*, *delirium*, *aphasia*, *coma*, *neuralgia*, and other *painful affections*, *inflammation*, *atrophy*, *hypertrophy*, and other *morbid alterations of nutrition and secretion*. After having mentioned clear and positive facts, showing that all these affections may be caused by an injury to, or a disease of, a nerve, I will briefly give the rules concerning the diagnosis and treatment of these effects of injuries and diseases of nerves. This essay will therefore consist of two sections: the first, relating to facts demonstrating the existence of a great variety of reflex and other remote effects of irritation of centripetal nerves; the second, giving the principal features and rules of diagnosis and treatment of these effects of diseases and injuries of branches and trunks of nerves.

Section I.—Affections of the Nervous Centres and other Organs, caused by an Injury to, or a Disease of, a Nerve.

Epilepsy.—Of all the nervous and other complaints that may be due to an irritation starting from the trunk, branches, or ultimate ramifications of nerves, very few, if any, are more frequent than epilepsy. Diseases of all the mucous membranes, or their irritation by worms, diseases of the cerebral or spinal meninges, dentition, &c., are known to be frequent causes of this convulsive affection. But it is not so well known, that an injury to, or a disease of, a nerve, not rarely produces epilepsy. Indeed, even a man of great authority as regards epilepsy, Dr. Herpin,[1] has lately maintained that in cases in which this affection seemed to have been caused by an external injury, it was, in reality, due to a disease of the nervous centres. It is most important that medical practitioners should not be misled by such an opinion. The rational treatment of that form of epilepsy which appears after a wound, or an organic affection, of a nerve, would certainly be neglected if such a view were admitted. It is, therefore, necessary to demonstrate that in a number of cases an epileptiform affection and also the most genuine epilepsy have been caused by a lesion of a nerve. This demonstration is given by the following kinds of proof:—

1st. In a great many cases, epilepsy has appeared in persons in whom there was no other cause for its production but a wound, a burn, a tumour, an inflammation, or a neuralgia.

2nd. In a number of the above cases a peculiar sensation, generally miscalled *aura epileptica*, arose from the seat of the irritated nerve before all or most fits.

3rd. In many of the same cases, the application of a ligature round a limb above the seat of the irritation often prevented the occurrence of fits.

4th. In some of the same cases a pressure on the seat of the external irritation invariably brought on a fit.

5th. In many cases of epilepsy apparently due to an irritation of a nerve, the section of that nerve above the seat of irritation, or the amputation of a limb; the extirpation of a tumour, of a cicatrix, of a decayed tooth, of a carious bone, &c., have cured the patients.

6th. I have discovered, in certain animals, that the irritation of the sciatic nerve by a broken bone, or by some other causes (crushing, tying, or cutting), invariably

[1] *Des accès incomplets d'épilepsie*, par Th. Herpin, p. 36. Paris, 1867.

produces a temporary or persistent epilepsy. This convulsive affection never disappears without treatment, unless the irritation has ceased in the sciatic nerve.

These various facts clearly prove that epilepsy may be due to an irritation of a nerve, and exists without any serious organic change in the nervous centres. For the details of cases like those I have mentioned I will refer the reader to the new edition of my work on Epilepsy, which will soon be published. I will only say here, that some of these cases have been observed by perfectly reliable men, such as Sir Astley Cooper, Sir Benjamin Brodie, Dieffenbach, Baron Larrey, &c. I will give one of those cases as a good specimen of reflected epilepsy. It was put on record by Dr. W. Laing of Aberdeen.

M. D., aged twenty-one, had the left hand lacerated by machinery. She went on well till the night of March 6, when she was seized with convulsions, and after a day or two, with trismus and other tetanic symptoms. On April 7 she was dismissed, *cured*; but on June 24 she returned to the hospital. About a fortnight before her readmission she suddenly fell down in an epileptic fit; and since, the attacks have become more and more frequent, recurring five or six times a day, and lasting about five minutes, after which she remained a considerable time in a state of stupor. On the 25th the fits were so severe that she was put in the strait-waistcoat. When the fits were slight, they were confined chiefly to the injured arm. On touching the fingers smartly, the arm was convulsively withdrawn; and when this was done while she was lying in a state of stupor, violent convulsions of the arm were produced. The patient often felt a sensation arising from the injured hand, previous to her fits. As the remainder of the hand was of little use, the fore-arm was amputated: the patient never had the slightest appearance of epilepsy after the operation, and was dismissed cured, a month afterwards. The digital branches of the median nerve, and a branch of the ulnar, were found enlarged to four or five times their usual size, and their extremities bulbous, and firmly embedded in a hard cicatrix.[1]

Tetanus.—Referring to the article on TETANUS in the first volume of this work, I will only say a few words on the important questions relating to the nature and to the local treatment of this affection.

I am really surprised that some persons still doubt that it is owing to a peculiar influence exerted, on the circulation of the blood and the nutrition of the spinal cord and the medulla oblongata, by the irritation of a centripetal nerve, that tetanus arises from a traumatic lesion. I hope that the following facts and reasoning will show that this convulsive affection is truly dependent upon an irritation arising from the injured nerves, and not—as Dr. B. W. Richardson, Roser, Billroth, and others are inclined to admit—from toxæmia.

The relation between the wound and tetanus seems to be positively established—at least, in those cases in which the muscles attacked with spasms are on the side injured. Lepelletier, Sir Gilbert Blane, Swan, Dupuytren, and Mr. Curling,[2] who cites the preceding authors, have seen such cases. My friend Professor G. H. B. Macleod [3] relates two cases of fatal tetanus, in which the tetanic spasms were almost entirely limited to the side injured. Baron Larrey states that when the wound causing tetanus is in the anterior part of the trunk, emprosthotonos is the form generally observed.

Other strong arguments in favour of the view that traumatic tetanus is caused by a peripheric irritation, are: 1st, that very frequently the muscles in the neighbourhood of the wound are either the first attacked or the most affected with spasms; 2nd, that in many cases it has been observed by myself and others, that even a slight pressure on the wound or the cicatrix has increased the existing spasms or produced them during periods of relaxation (after chloroformic anæsthesia, for instance).

It may seem strange that tetanus will sometimes follow even the slightest wound, and that it will come at any period of inflammation or cicatrisation, and even when there is no pain at all in the wound or its neighbourhood. But this last fact is not an objection to the view that tetanus takes place in consequence of an irritation

[1] Aberdeen Infirmary Reports, in *Lond. Med. Gazette* for Dec. 25, 1840.

[2] *A Treatise on Tetanus*, pp. 87, 174. London, 1836.

[3] See his excellent work, *Notes on the Surgery of the War in the Crimea*, pp. 155–161. 1858.

starting from these parts, as we know that all the morbid or normal influences on circulation and nutrition in the nervous centres, may proceed from the periphery, without any pain, or even without the least perceived sensation.

The kind of lesion which most frequently produces tetanus, implies that there is a great irritation of nerves, although there may be no marked pain. In a table given by Mr. Poland in this work (vol. i. p. 201), I find that out of 1,364 cases of major and minor operations at Guy's Hospital, there was but one case of tetanus; while out of 398 cases of compound fractures and 594 cases of wounds of all varieties, there were 18 cases of tetanus; giving a proportion, when the nerves were simply divided by a sharp knife, of one case of tetanus out of 1,364 patients; and of one case out of 55 patients, after wounds and fractures, when the nerves were bruised or much irritated. In a statistical table given by Dr. Friederich,[1] the influence of great irritation of nerves in causing tetanus is also demonstrated: out of 176 cases of that affection, only 11 occurred after amputation, and 33 after gunshot wounds, while 61 were due to contusion or comminutive fracture, and 71 to wounds by puncturing instruments, or dilaceration and bruising of tissues by nails, pieces of wood, &c. Dr. Lawrie's statistics agree with those of Friederich.[2]

The cases of cure of tetanus either by an amputation of a limb or by section of a nerve, clearly prove the dependence of this affection on an irritation starting from some peripherical part of a nerve. I will refer for a number of facts showing that the section of a nerve can cure tetanus, to a very good review of the meaning of treatment of that affection by Dr. L. G. Richelot.[3] The same conclusion flows out from facts like the following, to which I might add a great many others. Tetanus is pointed out to have been caused by a small splinter of bone sticking in the radial nerve (Hennen), by a portion of a whip embedded in the cubital nerve (Dupuytren), by an application of caustic potash on the coraco-brachial nerve (Frere), by shot corns in the tibial nerve (J. Hutchinson), by a splinter of wood in the radial nerve (Morgan), by neuritis (Curling, Lepelletier, Froriep, and others), by ligatures of nerves of limbs (Larrey, Béclard, Portal. &c.), by a small piece of broken bone passing through the peroneal nerve (Wutzer and O. Weber), by the crushing of the anterior tibial nerve between fragments of broken bone (Alquié), and by partial division or tearing of nerves (Swan, Liston, Billroth, &c.) In cases in which the spinal cord was either inflamed or rendered extremely excitable, the section of a nerve or an amputation has been of no avail; and in some cases, also, in which an inflammation had been propagated high up in the trunk of a nerve, towards its roots, these operations have been useless; but such failures might have been avoided had these modes of treatment been applied earlier, and had all the nerves been divided higher up than they have been. I need not say that the simple division of a nerve should always be preferred to an amputation, unless there are some special reasons for this last operation.

Hysteria.—The extreme frequency of this affection in women renders it difficult to prove that it may be due to an irritation of a nerve. However, there are cases in which it seems quite clear that hysteria was really caused by a wound, or the irritation of a tumour.[4]

Two very interesting cases are reported by Dr. Parsons;[5] one observed by himself, the other by Dr. S. P. Hildreth.

Morgagni mentions the case of a young girl, who, after a wound to a finger by the biting of a sparrow, was attacked with fits of trembling and screaming, recurring sixteen or eighteen times a day.[6]

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[1] *De Tetano traumatico*, Berolini, 1837.

[2] *The Glasgow Medical Journal* for Oct. 1853; and *The Association Medical Journal*, Nov. 18, 1853, p. 1017.

[3] *Revue des Sciences Médicales*, publiée par G. Hayem, 1878, vol. xi. p. 396 *et seq.*

[4] An interesting case, published by Hamilton (*Dublin Journal*, 1838, vol. xiii. p. 42), shows how careful we must be as regards the signification of symptoms in hysterical patients. All the most characteristic features of neuritis existed in a patient after a wound, but they disappeared *at once* after a violent fit of hysteria.

[5] *American Journal of the Med. Sciences*, April 1851, pp. 307, 312.

[6] *De Sedibus et Causis Morborum*, Lutetiæ, 1822, vol. vi. p. 613, epist. liv. § 45.

Raynaud relates the case of a woman, who, after having received a blow on the breast, had a first attack of hysteria. Two small tumours soon appeared at the injured place, and for seven years hysterical attacks occurred several times every day. These tumours were removed by Boyer, and immediately after the operation the attacks ceased, and did not recur again.[1]

Three years ago, in a patient of mine of a highly nervous temperament, but who never had had any marked symptoms of hysteria, convulsions and delirium, with some degree of lock-jaw, frequently appeared and ceased, during three or four days, after a slight wound by a needle in front of the knee-joint, just below the patella. The needle broke at the time of the accident, and a small part of it remained under the skin. As soon as the pain ceased in the little wound, after the extraction of the point of the needle, the patient got well, and has had no return of hysterical symptoms till she died five years after this accidental hysteria.

Brachet has seen a temporal neuralgia produce hysterical fits every time it appeared, and for all the time it lasted.[2]

Sir Benjamin Brodie mentions several cases in which a wound was the cause of hysteria.[3]

A very curious case of hysteria in a man, cured by the removal of a tumour of the external ear, has been published by Dr. Bastien, in his inaugural dissertation.[4]

In hysteria as in epilepsy, an aura starting from some point of the periphery of the body may precede an attack, and also the aura may be created by a pressure on some part. In those cases the same means of treatment as in epilepsy may prove useful. These facts, and the cases I have briefly mentioned, show that hysteria, like epilepsy and tetanus, may be caused by an irritation of a nerve. I must say, however, that a persistent cure of hysteria is very rarely obtained. Various operations, such as extirpations of cicatrices, amputations, &c., to cure hysterical spasms due to an irritation of nerves, have proved beneficial only for a time, in several cases of Sir Benjamin Brodie,[5] of Mr. Hancock, Tyrrel, and Bransby Cooper.[6]

Catalepsy.—I have seen a case of this affection in which attacks were brought on at once by even a slight pressure on tender spots between the shoulders. Catalepsy, therefore, may, like other neuroses, be produced by a peripheric irritation.[7]

Chorea.—St. Vitus's dance may be caused by an injury to a nerve.

In a case of Dr. Borelli, of Turin, chorea was caused by a neuroma of the foot, in a child thirteen years old. This convulsive affection was at once lessened, and in four days cured, after the extirpation of the neuroma.[8] Andral mentions a case of chorea caused by the irritation of a finger by a retroverted nail.[9] Dr. J. Malden has cured a woman of choreic movements by the extraction of a decayed tooth.[10] A case of chorea due to an injury to the trunk of a nerve is mentioned by Dr. Ch. Owen Aspray,[11] and another due to a wound by Dr. Kingston.[12]

Hydrophobia.—I will try to show elsewhere that the symptoms of this terrible affection depend on a local effect of the virus on the wounded nerves, and that some chance of cure might be obtained by division of the irritated nerves. Already in the last century, G. Hicks proposed this means of treatment against hydrophobia.[13] I owe to Dr. Stokes, of Dublin, the mention of a most important case, showing that there is good ground to hope that hydrophobia might sometimes be cured by amputation or division of a nerve.[14]

Tremulous movements.—The so-called *trembling palsy*, which so often consists

[1] Raynaud, in *Archives de Médecine*, 1829, vol. iii. p. 434.
[2] *Traité de l'Hystérie*, 1847, p. 253.
[3] *Lectures illustrative of certain Local Nervous Affections*, 1837, pp. 40–46.
[4] *Thèse inaugurale*, soutenue le 20 novembre, 1855. Paris.
[5] *Loc. cit.* p. 83.
[6] *Lancet*, March 20, 1852, pp. 281–283.
[7] Hufeland relates a case of attacks of involuntary *running* and of *catalepsy*, caused by a blow on the head, and cured by trepanation (cited by Roth, *Musculation irrésistible*, p. 32).
[8] *Gazette des Hôpitaux*, 1850, p. 454.
[9] *Cours de Pathologie interne*, vol. iii. p. 304.
[10] *Archives de Médecine*, mars 1855, p. 338; from *Trans. Provincial Associat.* vol. xix.
[11] *Lancet*, London, 1865, vol. ii. p. 65.
[12] *London Medical Gazette*, 1841, vol. xxvii. p. 489.
[13] *Lond. Med. and Phys. Journal*, vol. xvii. p. 277.
[14] The case above mentioned, and the reasons I have for the hope I have expressed, will be found in the Appendix to my work, *Lectures on the Physiol. and Pathol. of the Central Nervous System*, p. 261 *et seq.* 1860.

simply in involuntary tremulous movements, without any palsy, may be caused by an irritation starting from a nerve.

Sabatier [1] relates the case of a young man, who, after a wound of the saphænous nerve, near the knee, was attacked with violent trembling of the leg and thigh, which lasted many months. In a patient sent to me by Mr. Erichsen, an injury to a nerve of the left arm has produced trembling in both arms. In another patient, for whom I was consulted by Mr. M. H. Collis, of Dublin, shaking palsy began in a fractured limb, and thence extended to the other limbs. Several cases on record showing that the shaking due to an external injury may become general.[2]

Rotatory convulsions.—I have found that an injury to the auditory nerve in animals is at once followed by rotatory movements. I do not know of any case of wound of that nerve in man having produced the same symptoms; but several cases are on record in which these movements have been observed in man when the auditory nerve was irritated by an inflammation or some other cause (an injection of caustic, &c.)

I would refer for these cases to my work on the *Central Nervous System*, p. 195, only adding here, that since that publication I have seen five cases of that peculiar kind of involuntary movements, caused by an affection of the internal ear. An irritation of other nerves may produce the same effect. Dr. Kreig relates the case of a patient wounded on the forehead, and on whom a touch of the injured skin produced attacks of exceedingly rapid rotatory movements.[3]

Local convulsions.—It is well known that wounds of the branches of the fifth pair of nerves may by a reflex influence produce spasms of the muscles of the eyes, or trismus, or histrionic convulsions. It is known also that muscles of the limbs and trunk may be seized with either tonic or clonic reflected convulsions from an irritation of a nerve. Sneezing, hiccup, cough, and vomiting are sometimes also caused by the reflex influence of wounds. Spasms of the sphincters (*vesicæ et ani*), of the œsophagus, the larynx, &c., are also among the reflected phenomena not rarely caused by an irritation of superficial nerves.

Contracture of blood-vessels.—Many experiments establish that blood-vessels will contract by a reflex action.[4] In hysteria and other nervous affections a reflex vascular contracture frequently occurs.

An eminent American clergyman has given me the details of a most remarkable case of prolonged reflex contracture of blood-vessels, he himself being the patient. After having violently struck his leg (two inches above the knee) against a piece of paling-fence, he was soon apparently cured of the local injury; but an influence upon the blood-vessels of the limb showed itself; so that for a whole winter it remained extremely cold, and ever since, for twenty years, its temperature has been lower than that of the other leg. Swan [5] has also observed a case of permanent reflex contracture of blood-vessels. I will revert to this subject in speaking of reflex muscular atrophy.

Paralysis.—I will not enter here into the discussion of the great question of the mode of production of paralysis when caused by an irritation of a nerve. I will only say that there are two absolutely different kinds of paralysis produced by such an irritation: in one kind a congestion or even an inflammation takes place in a part of the nervous centres by an influence exerted by the peripheric irritation, and the paralysis then produced is accompanied by the usual symptoms of congestion or inflammation of some part of the brain or spinal cord; while in another kind the paralysis exists without any symptom of congestion or inflammation of the nervous centres. This second kind of paralysis caused by an irritation of a nerve I long ago considered as being most likely due, at least in some cases, to a reflex contracture of

[1] *Médecine opératoire*, vol. i. p. 254.

[2] *Inquiry concerning Constitutional Irritation*, by B. Travers, p. 115, 1826; and *Treatise on Diseases and Injuries of Nerves*, by J. Swan, p. 124, 1834.

[3] *Histoire de la Musculation irrésistible*, par le Dr. Roth, p. 78. Paris, 1865.

[4] See my researches on this subject, with my friends Dr. Tholozan (*Journal de la Physiol. de l'Homme*, etc. 1858, p. 497) and Dr. J. S. Lombard (*Archives de Physiol. norm. et pathol.* 1868, p. 688).

[5] *Loc. cit.* p. 157.

blood-vessels [1] in a part of the nervous centres. In the second edition of this work I stated that in some cases, if not in all, paralysis may also depend, however, on a peculiar influence exerted on nerve-cells, in these centres, by an irritation starting from peripheric nerve-fibres, producing what has been called *inhibition*, or, at any rate, changing the condition of activity of these nerve-cells. I have now very good reasons to believe that this mode of production of paralysis is the most frequent, if it is not a constant one, in cases of peripheric wounds acting on a nervous centre so as to generate a loss of voluntary movement. This cause of paralysis may coexist with a persistent spasm of blood-vessels.

Paralysis of the various muscles of the eye, including the iris, is pretty often observed in cases of wound of the infra- or supra-orbital nerves, or in cases of neuralgia. I have seen several cases of that kind of paralysis (caused by a neuralgia), and all characterised by their evident relations with that cause.

In a case, which I have carefully watched, a sprain of *one arm* at the elbow-joint soon produced a paralysis of *both arms*, but more marked in the uninjured arm than in the other. Every change in the degree of pain in the injured elbow was accompanied by a corresponding change in the degree of the paralysis. The pain has now ceased for twenty years, and the paralysis, which ceased with it, has never reappeared.

Baron Larrey states that almost all the men who received slight wounds of the shoulder in the Syrian campaign, were attacked with paralysis of the injured limb. These patients were cured in Egypt, where the air is purer than in Syria. In some, at least, of these cases, the paralysis was clearly due to an influence exerted on the nervous centres by the irritation of superficial nerves.[2]

Facial paralysis from a neuralgia is not rare; in one case this paralysis and neuralgia were both caused by the irritation of the infra-orbitalis nerve, and cured by the extirpation of the irritating cause, a piece of porcelain. (Jeffreys, quoted by Tillaux, *Des Affections chirurg. des Nerfs*, p. 15; Paris, 1866.) Fabricius Hildanus, quoted by J. Barthez (*loc. cit.* p. 83, vol. ii.), relates a case of paralysis of one arm, caused by a piece of glass in the ear. The arm may be paralysed by an influence arising from very distant nerves. Drs. S. W. Mitchell, Morehouse, and Keen,[3] give two interesting cases, in one of which the irritated nerve was the sciatic, and the other the crural.

Parsons mentions a case of paralysis of the face and arm, caused by a prick.[4]

Roche, in an able dissertation, relates the case of a physician, in whom general convulsions and afterwards complete paralysis of sensibility and motion in the left arm appeared, after the painful extraction of two teeth of the left upper jaw. There was also loss of speech, but no alteration of intelligence. In an hour the paralysis disappeared, and speech returned.[5]

As regards the lower limbs, I will simply refer to my work *On Paralysis of the Lower Extremities*, in which a number of facts show that a peripheric irritation of nerves may produce that form of loss of movement.

I will only say here that one of the lower limbs may be alone paralysed, as in a case by A. Boyer, in which an irritation from a dislocated elbow was (according to all appearances) the cause of paralysis of the corresponding lower extremity.[6]

Cases of more extensive paralysis are also reported by the three American authors I have named. Schenkius (Barthez, *loc. cit.* vol. ii. Notes, p. 41) has seen a case of general paralysis produced by a wound of the eyebrow. I have been consulted by an American officer, who became paralysed in a slight degree in the four limbs, chiefly the right arm and the left leg, from a gunshot wound of the cervical plexus, and partly also of the brachial plexus of the right side.

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[1] An eminent physician, trying to ascertain the correctness of a statement of mine, that an irritation of nerves of the kidney may, by a reflex action, produce a contraction of blood-vessels of the pia mater of the spinal cord, was unable to succeed, owing to the fact that, after having laid bare that nervous centre, he vainly looked for blood-vessels on the surface he had under his eyes. Had he waited some time, he would not only have seen blood-vessels appear, where he at first had not seen any, but he might have had the proof that there is a contraction of the blood-vessels of the surface of the spinal cord, powerful enough to render them almost invisible, and occurring when the incito-motor nerves of the skin and other parts of the back are strongly irritated in the operation of laying bare the cord.

[2] *Mémoires de Chirurgie militaire*, 1812, vol. ii. p. 153.

[3] Circular No. 6, *Reflex Paralysis*. Philadelphia, 1864. See also a paper on 'Paralysis from Peripheral Origin,' by Dr. S. Weir Mitchell, New York, 1866; and the work of the same writer, *Injuries of Nerves*. Philadelphia, 1872, p. 207 *et seq.*

[4] *Amer. Journ. of the Med. Sciences*, April 1851, p. 310.

[5] *Des Accidents nerveux traumatiques*, p. 65. Thèse. Paris, 3 janvier, 1861.

[6] *Gazette médicale de Paris*, 1834, p. 358.

I have seen a most interesting case of general paralysis, caused by an irritation of the nerves of the penis, cured by the successful treatment of balanitis and the operation for phimosis.

Hemiplegia from peripheric irritation is less frequent than partial paralysis or paraplegia.

There are, however, some remarkable cases on record. In one of them, published by Dr. Shearman, there was hemiplegia of the right limbs, caused by tic douloureux of the right inferior axillary nerve. Tonics and galvanisms cured the patient.[1] In another case, reported by Baron Larrey, a lady was attacked with hemiplegia on the same side where she suffered from a facial neuralgia, the hemiplegia being more evident during the attacks of neuralgia; both affections were cured by moxas.[2]

I have collected forty-two cases in which there was hemiplegia, due to an irritation of either the auditory or the trigeminal nerves near their origin, or of the crus cerebelli. I have tried to show elsewhere that, in those cases, the paralysis which exists in the limbs on the side of the irritated part is probably due to a reflex influence, or to inhibition.[3]

Sir Astley Cooper mentions the following fact: 'Mr. Toulmin attended a lady on account of her suffering severely from a diseased tooth, and she appeared also to be afflicted with hemiplegia. Mr. Toulmin extracted the tooth, and in a short time the paralytic affection entirely subsided.'[4]

Anæsthesia.—A reflex anæsthesia is not rare in cases of neuralgia.

Many cases of reflected anæsthesia from a wound and other injuries of nerves are on record. A remarkable case of Baron Larrey (*loc. cit.* vol. v. p. 35, 1821), and an important one of Roche (quoted in my *Lect. on the Centr. Nerv. Syst.*, p. 131), particularly deserve to be mentioned. I have observed anæsthesia of the arms in an able lawyer of London, which was caused by a blow on the back of one knee. Several interesting cases have been published by Drs. S. W. Mitchell, Morehouse, and Keen. In one case a shell-wound of the left thigh produced anæsthesia of the right thigh.[5] I have several times seen anæsthesia of the whole of one side of the face, in cases of neuralgia of one part of the trigeminal nerve on the same side. I have seen also a case of anæsthesia of a part of the forehead and face, in consequence of the irritation of a branch of the fifth pair, on the cheek-bone, by a bruise. In those cases the anæsthesia subsided when its cause was cured.

Amaurosis.—The cases of amaurosis due to an irritation of the trigeminal nerve are frequent enough for my dispensing with quotations of cases. In the first edition of this work I quoted cases of Wardrop,[6] Notta,[7] Dr. Noyes of New York,[8] and Mr. J. Hutchinson.[9] This last observer has since published several good papers on this subject. I have myself seen five or six cases of amaurosis evidently due to an irritation of the infra- or supra-orbitalis nerve. Cases of amaurosis due to an injury of a nerve of the trunk or limbs are not frequent. Dr. J. B. Colhoun has reported a remarkable case of sudden and almost complete amaurosis of both eyes, caused by a gun-shot wound of the scapula.[10]

[1] *Provincial Medical and Surgical Journal*, May 15, 1844.

[2] *Recueil de Mémoires de Chirurgie*, vol. v. 1821.

[3] *Lect. on the Physiology and Pathology of the Central Nervous System.* Philadelphia, 1860, pp. 201, 264; and *Doctrines relatives aux principales actions des centres nerveux.* Paris, 1879, p. 11.

[4] *Lect. on the Principles and Practice of Surgery*, vol. i. p. 6, 1824. Dr. Castle, of New York, mentions a case of paraplegia caused by decayed teeth, quickly cured by the extirpation of these teeth (*Lancet*, 1846, vol. ii. p. 267).

[5] See an excellent paper by Dr. S. Weir Mitchell, on 'Paralysis from Peripheral Origin,' reprinted from the *New York Medical Journal*, 1866, p. 59.—I have lately found that the irritation of the sciatic nerve in the lower animals, produces a slight anæsthesia of the lower limb on the opposite side, and of the face and neck on the side of the irritation. It is now pretty clear that reflex anæsthesia, as well as cerebral or spinal anæsthesia, has its principal cause in inhibition of cells and nerve-fibres. On the one hand, many facts show that even anæsthesia due to an organic disease of the nervous centres can be cured by galvanism; on the other hand, I have found that after having produced anæsthesia in a limb by a lesion of the base of the brain, I can not only make it disappear, but replace it by hyperæsthesia through the influence of another organic lesion (hemisection of the spinal cord). See *Comptes Rendus de l'Académie des Sciences*, vol. xc. 1880, p. 750.

[6] *Med.-Chir. Trans.* vol. xii.

[7] *Archives gén. de Med.-Chir.* etc. juillet 1854, pp. 12–21.

[8] *American Med. Times*, March 15, 1862.

[9] *Med. Times and Gazette*, May, 7, 1859, and *London Ophthalmic Hospital Reports*, 1865, v. iv. p. 381.

[10] *The Medical Examiner*, p. 806, vol. ii. Philadelphia, 1839.

Deafness.—A neuralgia of the face sometimes produces loss of hearing; other kinds of irritation of branches of the fifth pair may also cause deafness. Dentition and decayed teeth have been pointed out as having had the same effects. Pearson relates a case of wound of the thigh in which deafness was among the symptoms produced (*Medical Facts*, vol. vi. p. 109).

Loss of smell, taste and hearing.—The celebrated experiment of Magendie, showing that a section of the trigeminal nerve may produce a loss of the five senses, in the head, is a good illustration of the inhibitory influence an irritated nerve can originate. Magendie had concluded that the trigeminal nerve is a nerve of vision, of audition, &c., not only on account of the result of his experiment, but also because that nerve sends fibres to the eye, the ear, the tongue, &c. Clinical facts have shown, however, that an injury to one branch only of the trigeminal can produce in man the same effect on smell, taste, and hearing, which the section of the trunk causes in animals. So it was in cases of Blondlot[1] and of Bell,[2] in both of which an injury to the infra-orbitalis at once produced loss of smell and taste, with loss of hearing in one of the cases.

Collapse.—On this important subject I must say that experiments on several species of animals, compared with facts observed in man, have shown me that there are, at least, three different kinds of collapse :—the first, one in which a reflex arrest or diminution of the heart's action predominates; the second, especially characterised by a great diminution of breathing, produced by a peculiar inhibitory influence on the central organs of respiration, the heart continuing to beat with more or less vigour; the third, which was for the first time described in my lectures at the Faculty of Medicine of Paris in 1869, consisting in a powerful influence exerted by the nervous centres on the nerves able to act on circulation, secretion, and nutrition, so as to produce a cessation of most of, if not all, the ordinary interchanges between blood and tissues. In this third form of collapse blood-vessels are generally contracted. But whether they are so or not the blood, instead of being black, in the veins, is reddish and sometimes arterial-looking, and the production of heat ceases in the capillaries. This third form of collapse generally coexists with a diminution of breathing and a weak and often slow pulse. Whatever be the state of respiration and circulation, this is the most dangerous of the three kinds of shock or collapse.[3]

Neuralgia.—The frequency of *tic douloureux*, caused by an irritation of a small part of the dental nerves, is such, that it is certainly useless to mention cases. But tic douloureux may be caused by irritations of other nerves, while also an irritation of the nerves of the jaw may cause a neuralgia elsewhere than in the face. Mr. Harvey has seen a case of tic douloureux caused by a tumour of the head. It was ascertained several times that pressure on the tumour brought on a severe attack of tic. The patient was cured by the removal of the tumour.[4]

In the first edition of this work, I gave cases of reflex neuralgia reported by Mr. Gay,[5] Dr. R. Rowland,[6] Parsons,[7] Tavignot,[8] Dr. Greene of New York,[9] Wardrop,[10] Maréchal,[11] Dr. Castle of New York,[12] Marchal de Calvi,[13] and Romberg.[14] The view

[1] *Gazette médicale de Paris*, 1834, p. 44.

[2] *Bulletins de la Société Anatomique*, 1833, viii. p. 143.

[3] See my article on Syncope in *Archives de Physiol. normale et pathol.* 1869, p. 767. See also the remarkable work of Dr. F. E. Vincent: *Des causes de la mort prompte après les grands traumatismes.* Paris, 1878.

[4] *On the Nature and Treatment of Tic Douloureux*, &c., by Dr. Henry Hunt, p. 114, 1854.

[5] *The Lancet*, 1846, vol. ii. p. 119.

[6] *A Treatise on Neuralgia*, by R. Rowland, p 18. 1838.

[7] *American Journal of the Med. Sciences*, Oct. 1854, p. 423.

[8] *Gazette médicale de Paris*, 1845, p. 547.

[9] *Dublin Journ. of Med. Sc.* 1838, vol. xiii. p. 53.

[10] *Trans. of the Med.-Chirurg. Soc.* vol. viii. 1817, pp. 246 *et seq.*

[11] Case of Maréchal, cited by Marchal de Calvi, in *Annales de Chirurgie*, 1844, vol. iv. p. 69.

[12] *The Lancet*, 1846, vol. ii. pp. 266, 267.

[13] *Annales de Chirurgie, loc. cit.* p. 76.

[14] *Lehrbuch der Nervenkrankheiten*, 3rd. edit. vol. i. pp. 23–35.

I then maintained, that a neuralgia may be caused by a reflex action, being now pretty generally admitted, I only give here a reference to these cases, and to important publications made on this subject by Ch. Londe,[1] J. Mason Warren,[2] and Ch. Mauriac.[3]

Delirium.—I will simply mention here three cases which show quite decisively that delirium may be caused by an injury to a nerve.

A boy, aged fourteen, trod on a piece of glass, which penetrated the big toe, and was incompletely removed. Four years afterwards, he began suddenly to talk in a very strange, wild way; true delirium set in, and nothing appeased the patient. Near the ball of the big toe a small reddish elevation was found. The moment pressure was made upon it, the seizure returned with violence. An incision was made, and a trifling piece of glass was removed. Much as the patient had raved during the operation, with equal suddenness did all the symptoms vanish; and he was surprised on being told of all the senseless things he had uttered.[4]

I have published a case very similar to this, which I owed to the kindness of the late Mr. Campbell de Morgan, and in which the attacks of delirium took place every time pressure was made on a wound of a toe containing a foreign body. As soon as the irritated part was taken away by the cut of a bit of skin, the patient became rational, and remained so when pressure was made on the wound.[5]

Mr. Sherwin has seen a woman, who, after having been bled, was attacked with pains in the arm, neck, and face, with spasms in those parts, and delirium. After the symptoms had continued a fortnight, a deep incision above the cicatrix quite cured her.[6]

I need not speak here of the delirium that follows amputation or other great operations. The causes are many that bring on delirium in such cases. Among the principal causes I will point out a great loss of blood, and the anxiety of the patient.

Aphasia.—An interesting case shows that this affection also can be produced by an irritation of a nerve. Dr. Guyot has seen aphasia occurring every time an attack of facial neuralgia took place; the patient was cured by quinine.[7]

Inflammation.—Cases of inflammation of the eye due to a reflex action are so frequently met with, that there is no need of proving their existence. Anyone who will read the facts published by Dr. W. Mackenzie, in his valuable work on the Diseases of the Eye, by Mr. R. Taylor,[8] by Dr. Brondeau,[9] and by several other more recent writers, among whom I will only quote Dr. J. J. Maats,[10] a pupil of Prof. Donders, will soon be convinced that an inflammation of any part of one eye (the retina, the cornea, the conjunctiva, &c.) may be caused by a wound or an inflammation of the other eye; and that if the first diseased organ is extirpated, the other is often soon cured. Cases of ophthalmia owing to a wound or a neuralgia of the infra- or supra- orbital nerves, or caused by an irritation of the dental nerves, are also not rare. I will only refer to a good case of that kind published by Tavignot.[11] Dr. Busschaert has published a curious case of ophthalmia produced by obstruction of the external auditory canal.[12]

Dr. Rowland relates several facts which seem to prove that an inflammation in one side of the brain may be caused by an injury to a nerve in the other side of the body.[13] To the cases of inflammation of the brain mentioned by Dr. Rowland, I might add several others, among which the most significant have been recorded by

[1] *Rech. sur les Névralgies consécut. aux Lésions des Nerfs.* Paris, 1860.

[2] *Surgical Observations, with Cases and Operations.* Boston, 1867, pp. 468, 471.

[3] *Névralgies réflexes de l'orchite*, in *Gaz. méd.* Paris, 1869, Nos. 25 to 47; and 1870, Nos. 1 to 5.

[4] Joerdaens, apud *Hufeland's Journal*, vol. iv. p. 227, cited by Dr. Martin Payne, in his *Medical and Physiol. Commentaries*, vol. i. p. 425.

[5] *Course of Lect. on the Physiol. and Pathol. of the Nerv. Cent.*, p. 185. 1860.

[6] Duncan's *Medical Comment.* vol. iv., cited by Mr. Hamilton in *Dublin Journ. of Med. Science*, vol. xiii. p. 51, 1838.

[7] *Gazette hebdomad. de Médecine*, 1867, p. 266.

[8] *Medical Times and Gazette*, 1857.

[9] *Des Affections sympath. de l'un des Yeux.* Paris, 1858.

[10] *Nederlandsch Archief voor Genees- en Natuurkunde*, Deel ii. 1e Aflevering, pp. 8–52. Utrecht, 1865.

[11] *Echo Médical.* Neuchâtel, août, 1860, p. 371.

[12] *Gazette Hebdomadaire de Médecine*, 1854, p. 259.

[13] *On the Nature and Treatment of Softening of the Brain*, p. 67 *et seq.* London, 1851.

Hennen,[1] R. Bright,[2] and Champsaur.[3] The well-known fact that sometimes, in traumatic tetanus, the spinal cord becomes inflamed, shows that a peripheric irritation may produce inflammation in that organ.

Inflammation of the testicle is also sometimes produced by a reflex action from an irritated nerve, as in cases by Sir Benjamin Brodie,[4] Barras,[5] Marrotte,[6] and others. Sir Astley Cooper[7] says that by irritation morbid actions are excited in distant organs, and adds: 'thus inflammation is produced in the testicle from irritation in the urethra.'

Inflammation of the abdominal or thoracic viscera may also be produced by a reflex action. Proofs of this assertion are abundantly furnished in Lecture X. of my work *On the Central Nervous System*. A reflex inflammation may be brought on to such a degree as to cause an ulcer, which nothing can heal until the cause (viz. the irritation of a nerve) is removed. Sir Astley Cooper mentions several cases of that kind.[8]

As well shown by Mr. J. Hamilton, there is sometimes in cases of wounds of nerves, a deceptive appearance of inflammation with suppuration.[9]

Coma.—This most dangerous morbid state may also be caused by a peripheric nervous irritation.

In a case of Hirsch, quoted by Dieffenbach,[10] convulsions and coma accompanied local neuralgia, caused by venesection. The patient was cured by two deep incisions over the wound. An immediate cure of coma and convulsions was also obtained in a case similar to the preceding, observed by Dr. Wilson.[11] Another case, somewhat similar, has been recorded by Mr. G. Bell.[12]

Apoplexy.—Even apoplexy can be caused by a peripheric irritation.

A remarkable case of wound having caused neuralgia and apoplectic attacks has been observed by Dr. Maupin.[13] Other cases are mentioned in my old journal.[14]

Muscular atrophy.—I have seen a number of cases of atrophy of muscles produced by a reflex influence from an irritated nerve.

In one case *all the muscles of the thumb* wasted very rapidly after a deep wound of the ulnar side of the fore-arm having divided the ulnar nerve. This cannot be explained by the fact that that nerve sends a branch to two muscles of the thumb, as besides these two muscles, all the others, and especially the abductor and the opponens, were notably atrophied. Dupuytren[15] relates a case of reflex atrophy of the forearm and hand caused by a slight wound of a finger.

A neuralgia very often produces atrophy in neighbouring muscles. My friend and pupil, Dr. Cl. Bonnefin,[16] has seen nineteen cases of muscular atrophy caused by a neuralgia. A remarkable fact, observed in those cases, serves to explain how the atrophy was produced—there was a marked diminution of temperature, most likely due to a spasm of blood-vessels. The amount of blood was consequently diminished,

[1] *Military Surgery*, p. 191.
[2] *Reports of Medical Cases*, vol. ii. pt. i. p. 52.
[3] *Thèse inaugurale*, p. 22. Paris, 1860.
[4] *Lectures on Local Nervous Diseases*, p. 16. 1837.
[5] Cited by Notta, in *Archiv. de Méd.* etc., p. 547, sept. 1854.
[6] *L'Union médicale*, p. 155. 1851.
[7] *Lectures on the Principles and Practice of Surgery*, by F. Tyrrell, vol. i. p. 4. 1824.
[8] *Loc. cit.* pp. 7, 8.
[9] *Dublin Journal of the Medical Sciences*, vol. xiii. pp. 50, 55. 1838.
[10] *British and Foreign Medical Review*, p. 332, vol. xxi. 1846.
[11] *A Treatise on Diseases and Injuries of the Nerves*, by J. Swan, p. 117. 1834.
[12] J. Swan, *loc. cit.* p. 119.
[13] Quoted by Marchal de Calvi, in *Annales de Chirurgie*, vol. x. obs. 7, p. 73.
[14] *Journal de la Physiologie de l'Homme*, etc., vol. v. 1862, pp. 619, 621.
[15] *Leçons orales de Clinique Chirurgicale*. Paris, 1839, p. 95.
[16] *De l'Atrophie musculaire consécutive aux Névralgies*. Paris, 1860. A long list of authors having spoken of muscular atrophy caused by sciatica, is given by Dr. Lagrelette, in his exhaustive work on that kind of neuralgia, entitled *Etude histor. séméiolog. et thérapeut. de la Sciatique*, pp. 34–35. Paris 1869. See also Notta's paper in *Archives de Médecine*, sept. 1854, p. 557.

and the wasting occurred owing to the lack of nutritive fluid. Some of the cases of wasting palsy related in Dr. Roberts' excellent work,[1] very likely belong to the class of reflex atrophy.

In a case recorded by Vallez, a wound of the infra-orbital nerve produced a reflex atrophy and paralysis of the face on the same side.[2]

Atrophy of the cellular tissue.—In some of the cases of atrophy of one side of the face, which Schott and Romberg have called facial trophoneurose, there was an irritation of some sensitive nerve, probably acting by a reflex influence. I saw a case of that rare affection, three years ago in Boston (United States); its probable cause was an irritation of the dental nerves, which produced convulsions in one side of the face (the side where the atrophy was afterwards observed). I will refer for arguments leading to the conclusion that the cellular tissue is alone atrophied in that affection, to the remarkable essays of Dr. L. Lande and of Dr. Frémy.[3]

Hypertrophy.—Notta mentions cases of hypertrophy of the face and tongue caused by neuralgia.[4] I have seen a case of considerable hypertrophy of the bones and of the cellular tissue, in the face, which occurred after repeated attacks of neuralgia, in a lady whose general health was excellent.

Various kinds of alterations of nutrition and secretion.—The number of facts that might come under this head has considerably increased since the time that my friend Sir James Paget[5] first showed how great may be the direct and the reflex influences of the nervous system in disturbing nutrition. *Eruptions* of various kinds (*erythema, pemphigus, urticaria, acne,* and especially the different forms of *herpes*) are often produced by a reflex influence from an irritated nerve, as proved by facts observed by Rayer, G. Simon, Delioux, Notta, Romberg, Hasse, Parrot, and more recently by Charcot, Bärensprung, J. Hutchinson, H. F. Damon, Purdon, and others. I have seen several cases proving clearly the production of certain eruptions by a reflex action. Sir Astley Cooper relates a curious case of *fungoid granulations protruding through an ulcer* in the cheek of a lady, who was quickly cured after the extraction of a tooth.[6] In a case of *ulcerations* and wasting, probably due to neuralgia, Dr. Hooker cured the patient by dividing the popliteal nerve.[7] An *erysipelatous redness* and swelling has been seen by Sherwin in a case of wound of a nerve, and a *swelling* of the foot and leg has been observed by Dr. Watson of New York, in a case of a cut of the sole of the foot by a piece of glass.[8] *Œdema* is a frequent reflex effect of neuralgia. Hamilton has seen two cases of that serous effusion after injuries of nerves.[9] Those persons who know that even *gangrene* may be caused by an influence of the nervous system, as rendered so probable by Dr. M. Raynaud,[10] will not be reluctant to admit that it may be the result of a reflex influence from irritated nerves. Most likely it was not to embolism or to thrombosis, but also to a reflected nervous influence, that gangrene was due in three cases related by Sir William Fergusson,[11] Dr. Gubler,[12] and Dr. Grainger Stewart.[13] The case of Dr. Stewart is especially worthy of attention. I have frequently seen gangrene of the ear appear from a mere prick of the medulla oblongata in certain animals. *Altered secretions* are very often due to a reflex influence in cases of neuralgia, and sometimes in cases of wounds of nerves. *Diabetes* is most likely produced by a reflex

[1] *An Essay on Wasting Palsy.* London, 1858.

[2] *Gazette médicale de Paris,* p. 687. 1847.

[3] *Essai sur l'Aplasie lamineuse progressive,* par le Dr. Lande. Paris, 1869; and *Etude critique de la trophonévrose faciale,* par le Dr. Frémy. Paris, 1873.

[4] *Archives de Médecine,* juillet 1854, pp. 311–12.

[5] *Lectures on Surgical Pathology,* edit. of 1853, vol. i. p. 44.

[6] *The Lancet,* 3rd edit. 1826, vol. i. p. 27.

[7] *The Lancet,* vol. ii. 1859, p. 336; and *The Brit. Med. Journ.* Dec. 1866, p. 730.

[8] The cases of Sherwin and Watson are cited by Mr. Hamilton in *Dublin Journal of the Med. Sc.* vol. xiii. pp. 51, 54, 1838.

[9] *Dublin Journ. of the Med. Sc.* vol. xiii. pp. 41 and 43, 1838.

[10] *De l'Asphyxie locale ou gangrène symétrique des Extrémités.* Paris, 1862.

[11] *The Lancet,* vol. xiii. p. 152, 1850.

[12] *Comptes rendus de la Société de Biologie, pour* 1854, p. 76.

[13] *The Medical Press and Circular,* Jan. 10, 1866.

influence when it comes after a peripheric injury. It may be objected, however, that concussion of the brain is then its constant cause. I have not room enough to discuss the question here, but I think that the possibility of a reflex origin to mellituria is clearly established by cases like those reported by Dr. W. R. Hill, in which a burn was the cause of the secretion of sugar.[1] Cases of alteration of hair due to neuralgia or injuries of nerves are not rare, and I could easily mention many, showing changes in colour, in thickness, in abundance, and in rapidity of growth of hair.[2] *Cataract and glaucoma* have been pointed out also as evidently resulting, in some cases, from an irritation of nerves.[3]

Section II.—General Features and Rules of Treatment of the various Affections caused by an Irritation of a Nerve.

The following features usually characterise cases of neuralgia, paralysis, epilepsy, and other affections brought on by a peculiar influence, exerted upon, or through, a nervous centre, from an irritation of a nerve.

(1) Previous to the appearance of a more or less remote affection due to such an irritation, the patient has suffered for a variable time from a neuralgia or a neuritis, from a wound or a burn, or from pressure upon a nerve, by either a tumour, a displaced bone, or a foreign body.

(2) An increase or a decrease of the irritation of a nerve is often followed by corresponding changes in the intensity of the remote affections caused by the peripheric nervous irritation.

(3) The various modes of treatment of nervous and other affections, produced by an influence exerted on the nervous centres by a peripheric irritation, are generally quite unsuccessful so long as this irritation persists unabated.

(4) The various affections produced by a peripheric nervous irritation are frequently cured or relieved at once, or very soon after the removal of their cause, viz. the irritation.

I may add a few other characters, more or less implied, however, in the preceding: 1st. When remote affections due to a peripheric nervous irritation occur by fits, it is not rare to see the fit suddenly produced (completely or incompletely) when the diseased nerve is irritated by pressure, or otherwise (application of galvanism, for instance). 2nd. Narcotics, applied to the diseased nerve, will very frequently diminish, at least for a time, the remote affection, even, sometimes, when it consists in, or is connected with, a notable alteration of nutrition.

The above characters may all serve for the diagnosis of remote affections caused by a peripheric nervous irritation; but the only essential one consists, of course, in the pre-existence of a lesion of a nerve. It must be remembered, that if the trunk of a nerve is inflamed, all the symptoms spontaneously mentioned by the patient may seem to him to exist only at the terminal ramifications of that nerve. There is but one way to ascertain what the starting-point of these symptoms is: it consists in the examination, by pressure, of as much as possible of the whole length of the nerve, from the periphery to the neighbourhood of the brain or spinal cord. Had this rule been applied in the following case, it would not have been published and accepted as a case of reflected influence from a disease of the nerves of the thumb upon the four limbs.

Lady —— was attacked suddenly by an acute pain, soon followed by redness and swelling in the left thumb; and the other fingers gradually were also attacked, and afterwards the forearm. There was contracture and paralysis, with hyperæsthesia. The other arm became affected in a similar way; and when the pain was violent, there was paraplegia. No benefit

[1] Beale's *Archives of Medicine*, vol. ii. p. 172.

[2] I found lately that in some animals the division of the sciatic nerve is almost always followed, in two or three months, by a fall of hair in the neck on the side of the lesion.

[3] *Gazette des Hôpitaux*, 1846, p. 1; *Gazette méd. de Paris*, 1840, p. 130, and 1845, p. 546: and De Brondeau's dissertation, *Des Affect. sympath. de l'un des Yeux à la suite d'une blessure de l'autre œil*, pp. 40–46. Paris, 1858.

was obtained from powerful narcotic applications on the left thumb and hand; but the patient was cured after the use of a counter-irritant ointment rubbed over the arm.[1] In this case there had been no injury to the hand; there was no neuralgia; and the symptoms observed in the fingers and the forearm were those we find in cases of local meningitis, or inflammation of the sheath of nerves, at their exit from the spine. I have seen five similar cases, four of which were cured by counter-irritants applied to the spine.

The wonderfully powerful and varied influence exerted by an irritation of a nerve is not due to pain, but to an action of peculiar incident non-sensitive nerve-fibres, as is well proved by two sets of facts: first, that there may be no pain, and even no sensation of any kind, in certain cases in which, however, a peripheric nervous irritation causes a neurosis,[2] or another affection, as, for instance, in cases of worms in the bowels; secondly, that we every day see cases of pain from neuralgia, or other diseases of nerves, without the production of any remote affection. In only a few cases seen by myself or others, was there such an agonising pain as in a patient, in whom a ball had lodged in the trunk of the radial nerve, producing for many days the most excruciating pain, depriving him of sleep, and causing a continued perspiration from his face, without any other marked reflex action than a contraction of the forearm upon the arm.[3]

It may seem quite surprising, and perhaps incredible, that the same cause, viz. an irritation of a nerve, will either produce no effect at all, or produce such a variety of affections as I attribute to such a cause. But those who will take the trouble of studying the variety of effects of a clear cause of reflex action, such as, for instance, the exposure of many people to a cold wind when they come out perspiring from a very warm room, will understand that reflex effects may be exceedingly various, although resulting from the same peripheric cause.

Treatment.—Of the various means of treatment of the reflex and other remote effects of the irritation of a nerve, the most important may be classed into two groups—the local and the general means. As regards the local means, they consist chiefly in applications of revulsives or sedatives, or in an amputation or division of a nerve; while the general means consist chiefly in the use of remedies that will diminish the reflex power, or the morbid excitability of the irritated nerve.

Local means of treatment.—Of these means, the best theoretically are also the best practically, according to the mass of facts I have collected. The section of the injured or irritated nerve between the brain or spinal cord and the part of the nerve which is altered, is certainly the most important local means. I hardly need to say, that if this operation is to be performed, the sooner the better, in cases of hydrophobia, epilepsy, tetanus, reflex neuralgia, paralysis, &c. Of course, if there is any reason to fear that the irritating cause will persist after the time necessary for the reunion of the parts of the divided nerve, an excision of an inch or two, which will retard reunion, must be made instead of a simple division. There is no doubt that in a number of cases (especially those of long duration) this operation will not succeed; and there are many discouraging facts showing that the alteration of nutrition produced at a remote distance from the irritated nerve will continue after the division of the nerve, owing to causes yet undiscovered, or to an inflammation of the nerve in a great length between the place of the section and the nervous centres. It would be prudent always to excise at least a very small part of the length of the nerve, to ascertain, by a microscopical examination, if it is inflamed at the place of the operation; as, if such be the case, another division ought to be performed much higher up, and even as near the nervous centre as safely as possible. In a most valuable paper of Messrs. Arloing and Tripier,[4] they give good reasons for the division of all the nerves of a limb in cases of tetanus; but I do not think that this

[1] Case of Pearson, in *Med.-Chir. Trans.* vol. viii. pp. 252 *et seq.* Pearson does not speak of the spine. Had he examined it, he would have found great tenderness between the shoulders and a little above.

[2] See my *Researches on Epilepsy*, p. 17. Boston, 1857.

[3] Case of Denmark, in *Med.-Chir. Trans.* 1813, vol. iv. p. 48. The patient was cured by the amputation of the arm.

[4] *Archives de Physiol. normale et pathol.* p. 245, 1870.

radical proceeding is essential in a large proportion of cases of tetanus.[1] Still less would it be essential in most other affections due to peripheric irritation.

There are cases in which, instead of dividing a nerve, all that is necessary is to gain a few days to allow a wound to heal up. I proposed, several years ago, to make use, in those cases, of a simple means, consisting in laying bare the nerve above the wound, and in dropping sulphuric ether upon it. This operation, especially if ether is often applied, may render the nerve, for many days, quite unable to transmit any irritation from the original wound.

Amputation of a limb should never be resorted to with the view of curing reflex epilepsy, tetanus, &c., unless, of course, this operation happens to be necessary for another purpose.

In hydrophobia, besides the section of the nerve at a notable distance from the wound, it would be prudent, after a double section, to withdraw the whole length of the nerve from the place of the upper section to the place of the lower one, which should be near or below the original wound (*i.e.* the bitten part).

Next to neurotomy, subcutaneous injections of narcotics just above the wound, or on the irritated nerve, together with applications of emollient and narcotic lotions, or poultices, on the wound itself, are among the best local means. I have sometimes obtained the cure of chorea, of irregular attacks of convulsions, of *reflected* neuralgia, and even of epilepsy (three cases), by such subcutaneous injections of narcotics in gradually increased doses (from half to two-thirds of a grain of morphia, together with from one-sixtieth or one-fiftieth to one twenty-fifth of a grain of atropine).

I have derived some benefit also in cases of epilepsy with a distinct peripheric aura, from applications of temporary circular blisters, like a ring, around a limb or a finger.

Applications of ether spray, of ice, or even sometimes of a freezing mixture, on the spot where a nerve is wounded or irritated, might be sufficient to produce a cessation of its influence on the nervous centre or another organ. Induction of local anæsthesia by applications of ether spray just upon and above the wound might also be employed with benefit. Before dividing a large nerve, or several nerves, one of these means should be tried.

The actual cautery, applied at white heat, may also be extremely useful. It is perhaps the best, and can certainly be one of the least painful, counter-irritant means.

I need not say that foreign bodies, tumours (neuromatic and others), or vicious cicatrices, &c., giving rise to reflex affections, should be extirpated.

As regards Nussbaum's proceeding, *i.e.* stretching of nerves, I will speak of it in a separate part of this article.

General means of treatment.—After anæsthetics, the most powerful agents to subdue the reflex excitability of the nervous centres are the bromides of potassium and ammonium, belladonna, Indian hemp, aconite, hyoscyamine, ergot of rye, and turpentine; to which list now a few other substances, such as the hydrate of chloral, the chloride of baryum, and Calabar bean can be added. It ought to be remembered that in many cases of reflex affections, the most powerful narcotics, especially opium, and also other remedies, such, for instance, as the chloride of baryum, may be borne in very large doses without any poisonous effect. It would be impossible to say more as regards the general treatment without entering into details which the lack of room prevents my giving, and also because the rules must vary considerably according to the kind of reflex affection to be treated, and the special features of each case.

C. E. Brown-Séquard, M.D.

[1] The *Boston Medical and Surgical Journal* (March 31, 1870, p. 238) gives a case of severe traumatic tetanus, cured by exsection of the internal plantar nerve. Dr. G. E. Foster, who reports the case, stated that 'no spasm of any kind' occurred after the operation.

DISEASES AND INJURIES OF NERVES.

PART III.

SUTURE AND STRETCHING OF NERVES.

IN the previous parts of this article I have said but little of suture, and still less of stretching of nerves. These modes of treatment, especially the last, have lately been used so extensively that it is essential to give a separate account of these therapeutic operations. I will first speak of suture.

Suture of nerves.—Although far less important than it was thought to be for a year or two (1864–1865), this operation is a very useful one. It is perfectly well known, however, that reunion and regeneration of nerves, with return of the lost functions, can take place not only without the suture of the divided ends of a nerve, but also when a long piece of a nerve has been excised and thrown away. Reunion and regeneration can take place twice in the same nerve without suture. I have attended a patient, whose face was not only sensitive, but endowed with a greatly increased sensibility to touch, to tickling, to heat and cold, and to causes of pain, although the infra-orbitary nerve had been twice excised, by Sir William Fergusson. As regards the length of nerve that can be reproduced, I should not like to assign any limit to the regenerating process. I showed recently to the Biological Society the hind limb of a small monkey on whom, in two months and twelve days, nearly the whole extent of the sciatic and tibial nerves had been reproduced, after an excision of twelve centimetres ($4\frac{2}{3}$ inches). The motor and sensory functions had not yet returned.[1]

Notwithstanding the denial of Eulenburg and Landois, it is now perfectly well established that suture hastens, or otherwise helps, reunion and regeneration of divided nerves. In comparative experiments which I have made on young animals, I have obtained results very nearly similar to those of Vulpian and Philippeaux, who say that the function of divided nerves without suture will usually return in four or five weeks, while it can take place in seventeen days after suture. I never saw it occur in ten days (Schiff), or in nine days (Magnien). Béclard, sen., Sir James Paget, and many other surgeons, have seen cases of rapid regeneration and return of function, especially in young patients, when divided nerves had not been submitted to suture. In 1864, an attempt was made to prove that divided nerves can heal by primary union, and recover almost immediately their function, if the cut ends are placed in front of each other and held there by suture. Professor Laugier[2] announced that, in a case of complete section of the median nerve and incomplete section of the radial, he made use of suture for the median, in the morning, and found, in the evening, that sensibility existed in all the parts receiving fibres from that nerve. A few days after Houel communicated a similar case to the Paris Surgical Society. These cases prove nothing as regards the rapidity of reunion and return of function. Cases are numerous in which a division of one, or even two, nerves of the arm has taken place without loss of feeling in the arm or forearm or hand. Lenoir, Horteloup, Von Burns, Kraussold, Leudet and Delabost have recorded such cases. This is more frequently observed when it is the median nerve

[1] See *Comptes rendus hebdomadaires de la Société de Biologie*, Paris, 1882, p. 30.
[2] *Comptes rendus de l'Académie des Sciences*, vol. lviii., June, 1864, p. 1139.

which is divided than when it is the radial, and still more the ulnar nerves, which are cut. Sensibility may persist although diminished, even when most nerves of the arm have been divided. So it was in a case of Baudens, in which the radial was almost the only brachial nerve not injured. The explanation of these singular facts has been given by Arloing and L. Tripier.[1] They have proved that the various nerves send to each other recurring ensiform or loop-like fibres, which, coming by one of them from an anterior spinal root, goes into another, to ascend to the spinal cord through a posterior root, producing, when acted upon in one nerve, an impression which follows the loop, and then ascends to the cord through the other, giving rise to the so-called 'recurring' sensation, so well studied by Magendie and Bernard.

It is now quite proved that a *primary union* of the divided ends of a nerve is only an appearance of union, a cicatricial, not a physiological one; that the distal or lower end must pass through the process of degeneration so graphically described by Augustus Waller, and that new elements must be produced. Therefore the importance of suture does not consist in rendering healing easy by preventing degeneration, but in allowing regeneration to take place quicker. In this respect some cases of Verneuil, Gluck, and others are certainly demonstrative; but no case has as much value as one of Mr. Hulke,[2] in which a sutural junction proved successful fifteen weeks after division of the ulnar nerve. Both bulbous ends of the nerve had to be cut away, and as they were three-quarters of an inch apart, the upper end was stretched and drawn down, and joined to the lower one by silk sutures. The discussion on that case and some others, at the Clinical Society, is well worth reading.

In conclusion I will say—1st. that in recent cases of injury in which there are reasons to suppose that the ends of divided nerves are not very near each other, they ought to be drawn so as to touch each other, and be kept so by suture (catgut sutures to be preferred to silver or silk ones); 2nd. that in cases of injury of nerves, with long persistence of loss of their function, the process instituted by Mr. Hulke ought to be followed, however long the time elapsed since their injury.

Stretching of nerves.—We owe to Professor Von Nussbaum, of Munich,[3] the first operation of that kind. He was led to make the trial in a case of most painful and persistent cramp, by two facts, which were not sufficient, however, to authorise the boldness of that new process. He recollected that, in 1860, he had resected the elbow-joint in a scrofulous girl, and released the ulnar nerve from strong adhesions, with the result of curing a contracture of the third and fourth fingers. He also remembered an operation of Professor Billroth,[4] who had obtained a cure in a case of epilepsy, by dissecting and rubbing the sciatic nerve. Since Nussbaum made his first publication, nerve-stretching has been used, and perhaps abused, in cases not only of mere nerve affections, but also in a great many other affections. Before, however, speaking of the various kinds of disorders or diseases, in which it has been employed, it is essential to say a few words on several questions relating to the effects of stretching on the nerves themselves and on the nerve-centres.

(1) *Weight that can be borne by nerves without being torn.*—Dr. Tillaux[5] has ascertained on two human corpses that the sciatic nerve, being drawn down, did not break till the weight it had to support was fifty-four kilogrammes in one case and fifty-eight in another. In these corpses the median and ulnar nerves individually resisted till the weight was twenty or twenty-five kilogrammes, and both together till it was thirty-nine kilogrammes. Mr. Johnson Symington[6] has found that the sciatic nerve can bear a heavier weight than was the case in Tillaux's experiments. Out of fourteen observations on the dead body, in which weights were rapidly attached to that nerve immediately below the glutæus muscle, 130 lbs. (*i.e.* more

[1] *Archives de Physiologie normale et pathol.*, Paris, 1869, vol. ii. pp. 33 and 313.
[2] *British Medical Journal*, 1879, vol. i. p. 819.
[3] *Deutsche Zeitschrift für Chirurgie*, 1873, Bd. i., Heft 5, p. 450.
[4] *Archiv für Klinische Chirurgie*, Wien, Bd. xiii., 1872, p. 379.
[5] *Des affections chirurgicales des Nerfs*, Paris, 1866, p. 11.
[6] *The Lancet*, London, 1878, vol. i. p. 904.

than 60 kilogrammes) was the average weight found necessary to rupture the nerve. The maximum was 176 lbs. and the minimum 86 lbs., in the body of a young female. Gillette,[1] on the dead body of old men, has found that the sciatic nerve breaks, or is drawn away, under a weight of 75 to 100 kilogrammes. In the dead body of a vigorous adult the breaking only took place under the enormous weight of 300 kilogrammes, more than 600 lbs. The median and the ulnar required from 45 to 60 kilogrammes, a weight more than double that mentioned by Tillaux. The following weights are those indicated by Trombetta[2] as being those required to break the nerves mentioned; sciatic, 84 kilogrammes; internal popliteal, 52 kilogrammes; crural, 38 kilogrammes; median, 38 kilogrammes; ulnar, 27 kilogrammes; radial, 27 kilogrammes; brachial plexus (neck), 22 to 29 kilogrammes; brachial plexus (axilla), 16 to 37 kilogrammes; infra orbitalis, $4\frac{1}{2}$ kilogrammes; supra-orbitalis, 2 kilogrammes and 720 grammes; mental, $2\frac{1}{2}$ kilogrammes. These facts are important in showing the safety of surgeons practising nerve-stretching, as certainly they will not employ a force at all like that which is necessary to tear a nerve, at least in the limbs. My experiments on living animals show, as a rule, that to break the sciatic nerve, a weight superior to that of the body of the animal is necessary. In guinea-pigs weighing from 300 to 400 grammes, that nerve broke only when the nerve was drawn down by a weight above 600 grammes, and in one case more than 700 grammes was required. In rabbits the tearing of nerves is (proportionally to size) easier than in guinea-pigs. In dogs and monkeys it requires always a much greater weight than that of their body to tear the sciatic nerve. In a monkey weighing 3,100 grammes, the sciatic nerve, under gradually increasing weights, did not give way when it had to support 3,650 grammes, but did so under 3,680.

(2) *Extent of stretching that takes place in nerves before they break.*—Tillaux[3] says that the median and the ulnar nerves, in man (after death), broke only after having been extended from fifteen to twenty centimetres (six to eight inches). P. Vogt[4] has not found so great an extension; he has only seen ten centimetres. My experiments on living animals agree more with those of Vogt than with those of Tillaux. The greatest stretching I have seen was on a monkey: it was hardly more than two inches. The ulnar nerve in man and the sciatic nerve in the monkey I experimented upon are of the same size. It is likely from some comparative researches I have made, that the much greater extensibility of the ulnar nerve in a dead body than that of the sciatic in a monkey depends, not on a difference of species, but on the fact that living nerves will break easier than dead nerves, and that, therefore, they cannot be so much extended.

(3) *Changes in structure under stretching.*—It does not require considerable stretching to produce structural changes in nerves. Their lymphatics and capillaries are easily torn, and congestion with serous effusion and ecchymoses are found. This is seen even when there is no greater stretching than by a weight of sixty or eighty grammes (two or three ounces) in a mammal. Somewhat greater distension breaks in pieces the medullary substance of the nerve-fibres. Within two or three days the well-known Wallerian degeneration is already evident in many fibres of the nerve. If the stretching is considerable (250 grammes, for instance, for the sciatic nerve of a guinea-pig, weighing 300 grammes), all the fibres are altered.

(4) *Alteration in physiological properties and loss of function in stretched nerves.*—There is, sometimes, from a slight stretching an increase of excitability in motor and in sensitive nerves. But if the stretching is somewhat considerable, paralysis and anæsthesia, more or less complete, will appear and will last a variable time, according to the degree of structural changes in the nerve. No return of function can be expected in cases in which no trace of amelioration appears before a few days; and as it is clear then that the Wallerian degeneration is taking place, no sign of return of function is to be expected before regeneration has at least begun.

(5) *Mode of influence of stretching of a nerve on the nervous centres.*—Many

[1] *Revue de Chirurgie*, Paris, 1882, p. 138.
[2] *Sullo Stiramento delli Nervi.* Messina, 1880.
[3] *Loc. cit.* p. 12.
[4] *Die Nervendehnung als Operation in der Chirurg. Praxis.* Leipzig, 1877.

experimenters have maintained that no influence is exerted by the stretching of at least most nerves on the nervous centres. If their denial of an influence on those centres concerned only the supposed power of stretching to make an organic change in those centres, there would be no positive reason to dissent from them; but some of them deny also that any other kind of influence is exerted on the nervous centres by the stretching of a nerve. As a good part of the usefulness of stretching as a therapeutic means would have to be doubted if that view were right, it is necessary to show that various kinds of influences may be exerted on the nervous centres and through them to many parts of the body, when a nerve is stretched. In the first place, I will say that for more than three years I have been engaged in experimental researches which show that even a somewhat slight irritation of any nerve containing centripetal fibres cannot be made without at least dynamic changes occurring in all parts of the nervous system, changes consisting in some parts in an augmentation, and in some other parts in a diminution of power. In the second place, we well know that organic changes will occur in the nervous centres, and through them elsewhere, from an irritation, sometimes slight, of almost any nerve having centripetal fibres. This is, I believe, clearly established in the second part of this article (see *ante*, p. 199). In the third place, some experiments on nerve-stretching (which, of course, is a cause of great irritation of that nerve) have clearly shown that the properties and functions of the nervous centres and other parts are modified by that operation. If, for instance, as I have often seen, a transversal section of a lateral half of the spinal cord be made at the level of the tenth dorsal vertebra on a dog or on a guinea-pig, and if then, after ascertaining that, as usual in such cases, there is hyperæsthesia in the leg on the side of the injury to the cord, and anæsthesia in the leg on the opposite side, I stretch without great force the sciatic nerve of the anæsthetic limb, I find that in most cases not only sensibility returns in that limb, but that it soon acquires a morbid degree, so that hyperæsthesia replaces there anæsthesia. Besides, I find also that the limb which was previously hyperæsthetic becomes still more so. A clearer proof of a great change in the spinal cord could not exist. In the fourth place, I will say that in many cases of considerable stretching of the sciatic nerves in guinea-pigs, I have found the toe innervated by fibres from the crural nerve, anæsthetic like the other toes which receive their nerve-fibres from the sciatic. Sometimes even the leg on the opposite side to that of the operation becomes also anæsthetic. In one case there was an incomplete paralysis and anæsthesia in the right leg after considerable stretching of the sciatic nerve on the left side. It is clear, then, that the spinal cord is modified by stretching of a nerve. I will only add that, if a slight stretching can increase the power of the spinal cord, as regards sensibility, the same operation, if very energetic, will diminish or destroy for a time the power of that organ as regards that property.

I now pass to the examination of cases in which stretching of nerves has been used as a therapeutic means against various affections.

a. Nerve-stretching against neuralgia.—There is no doubt that a number of cases of inveterate neuralgia have been treated with success by that process. In a valuable paper of Mr. W. J. Walsham,[1] cases are mentioned in which the cure yet persisted after five months (two cases, one of Mr. Walsham, one of Dr. G. Stewart), seven months (one case of Mr. Spence), fourteen months (one case of Mr. Callender), eighteen months (one case of Mr. Bartlett). After nerve-stretching in many other cases, the cure had not perhaps been long enough to be sure that it would be permanent, insomuch that the cessation of pain very frequently is only due to the structural lesions caused by stretching, and it is to be feared that, after regeneration in those cases, as in those of neurotomy, the neuralgia would return. It is evident that, of the two surgical processes in cases of neuralgia, neurotomy and nerve-stretching, the last is the most useful, and that which offers the least danger especially for certain nerves : the infra-orbitalis particularly. Still I hold the opinion that certain modes of treatment are more powerful than nerve-stretching. I will refer to the second part of this article

[1] *British Medical Journal*, 1880, vol. ii. p. 1009.

(see p. 213) for the prescription of a narcotic subcutaneous injection, and for the rules as regards the use of the actual cautery. These means employed simultaneously leave so few cases of neuralgia uncured, that they ought to be tried before having recourse to nerve-stretching. It is not so in those terrible cases of so-called epileptiform neuralgia, such as was that of Mr. Walsham, and as was also a case of Dr. Grainger Stewart.[1] Nerve-stretching is then one of the very best means. In Dr. Stewart's case, the stretching of the infra-orbitalis proved insufficient, and the cure was obtained only after the stretching of the mental nerve. In cases of ordinary, although violent, neuralgia, it may not be necessary to stretch more than one nerve, even when a number of others are affected. This is clearly proved by a case of Masing,[2] in which almost all the branches of the trigeminal were attacked, and in which, however, a cure was obtained by stretching the infra-orbitalis alone. This fact is important in showing that the stretching of one nerve can, through the nervous centres, affect other nerves. Another point of some importance seems to come out from a case of neuralgia, in which the sciatic nerve was stretched by Morton without any marked benefit, and which was cured by excision of part of that nerve. In all cases in which excision is to be resorted to, there would be some benefit in stretching the nerve before practising excision.[3] Pooley[4] gives as a reason in favour of nerve-stretching in neuralgia, the probability of ameliorating the trophic troubles which often exists in that affection. This is right if stretching is sufficiently strong to alter all the fibres of the nerve, as then they are exactly as if the nerve had been divided—a condition which leads to the cessation of the trophic disorders, which, as I have established, depends not on the *absence* of a supposed favourable nervous influence, but on the *existence* of a mischievous influence exerted on nutrition by an irritated nerve.

b. Nerve-stretching in cases of spasmodic tic and local tonic spasm.—The first case of this kind is the one in which, for the first time, stretching was used by Nussbaum.[5] From blows on the nape of the neck and the elbow, a man had contracture of the muscles of the thorax, and of the arm, forearm, and hand. The ulnar nerve and several branches of the cervical and brachial plexuses were stretched and the patient was cured. Gartner, according to Nussbaum,[6] stretched, with some success, the brachial plexus in a case of rigidity and great pains. In a remarkable case of blepharo-spasm with neuralgia, Professor Panas[7] obtained a cure by stretching the infra- and supra-orbitalis. Kocher[8] and others have had a similar success in cases of blepharo-spasm. So far the cases of spasmodic facial tic have not found in nerve-stretching a very useful means of cure. A good paper of Bernhardt[9] contains three cases of stretching of nerves, twice against tic, once against spasm of the muscles supplied by the spinal accessory. A very slight or only temporary amelioration was obtained in the first two cases, and no amelioration at all in the last case. In the two cases of facial spasmodic tic the nerve stretched was the facial. In other cases the nerve extended was a branch of the trigeminal. It is clear that if the operating surgeon, in Bernhardt's cases, had drawn sufficiently on the facial nerve, he would have produced an alteration equivalent to the section of the nerve, and would then have had at least a temporary cure, but at the expense of a paralysis of more or less long duration. The same thing can but partly be said of the case of spasm of the muscles innervated by the spinal accessory. I say 'partly,' because those muscles receive some nerve fibres from other sources, so that even the section

[1] *British Medical Journal*, 1879, vol. i. p. 803.
[2] See *Contribution à l'étude de l'élongation des nerfs*, par E. Wiet, Paris, 1882, p. 113. A large number of cases of stretching for neuralgia and other affections has been collected and published by Dr. Wiet.
[3] A case of Credé supports this view. See *London Medical Record*, Oct. 15, 1880.
[4] *The New York Medical Record*, 1880, p. 172.
[5] *Deutsche Zeitschrift für Chirurgie*, Sept. 1872, vol. i. p. 450.
[6] *Loc. cit.* p. 462.
[7] *Archives d'Ophthalmologie.* Août, 1881.
[8] Quoted by Wiet, *De l'élongation des nerfs.* Paris, 1882, p. 110.
[9] *Zeitschrift für Klinische Medicin*, Berlin, Bd. iii. 1881, p. 100.

of the spinal accessory nerve is not always followed by an absolute cessation of the spasmodic movements of the neck and other parts. Mr. F. A. Southam [1] was more fortunate than Bernhardt, as he obtained an almost complete cure in one case of stretching of the spinal accessory against torticollis, but he gained only a very slight improvement in another case. He and others [2] were successful in cases of spasmodic jerkings of the facial muscles. There has been a facial paralysis in most of, if not in all, the cases of stretching of the facial nerve. In the case of Dr. Allen Sturge, and Mr. Godlee, although the nerve was extended 'with moderate force' (but this was repeated till paralysis appeared), two months after the operation the paralysis was still complete, and began to yield only after three months, but then improved rapidly. In Schlüssler's case, as well as in two cases of Eulenburg, and that of Putnam's, the paralysis lasted many months. In the cases of Baum, it is the more surprising that the paralysis only lasted eight days, that Baum had thought fit to crush the nerve with the forceps. The paralysis began to disappear after five weeks in Mr. Southam's case. I believe I can conclude that there is no affection in which nerve-stretching has proved as favourable as in spasmodic tic without much neuralgic pains.

The attempts made so far in cases of pains and spasmodic rigidity with hemiplegia have not been successful enough to give much encouragement. I have seen in a monkey, paralysed from brain disease, an excessive rigidity disappearing completely (gradually in two days) in the hind limb after stretching of the sciatic nerve; but the contracture returned in a few weeks and hardly diminished after a renewed stretching. Nicaise,[3] on a hemiplegic patient of Dr. B. Ball's, stretched the sciatic nerve to the extent of seven centimetres, without any marked effect on either the pains or the contracture of the paralysed leg. Czerny,[4] in a case of hemiplegia with pains, convulsions, and rigidity of the arm, was somewhat more fortunate. He first stretched the axillary plexus, and found that the rigidity diminished, and that the movements became easier; but after stretching the supra-clavicular plexus, the paralysis increased. There was, however, a complete cessation of very troublesome convulsions of the arm. In cases of rigidity or convulsions due to affections of the spinal cord, *without locomotor ataxy*, a somewhat favourable result has been obtained twice from stretching of the sciatic nerve. In a case of double lateral sclerosis, Mr. Southam [5] obtained this most remarkable result, that although the nerve was stretched on one side, the shooting pains disappeared from the two lower limbs; but the rigidity diminished only in the limb operated upon. In a case of Nussbaum's [6] there were clonic convulsions from the knee to the thorax with intense pain, owing to disease of the lower part of the spinal cord. Stretching of the sciatic nerve on one side cured the spasms and pains on that side; the same operation on the other side acted in the same way on the symptoms in this last side.

Nerve-stretching in tetanus.—As this subject must be fully treated in the article on Tetanus, I will only make the few following remarks:—1st. That the proportion of cases in which a cure of tetanus was obtained by, or at least after, nerve-stretching (even sometimes when the symptoms were quite severe), is too large for our rejecting that mode of treatment, notwithstanding the sharp, but in a measure only, well-founded criticism of Mr. Henry Morris [7]; 2nd. That even in cases of failure there was often a considerable amelioration from that means of treatment, so that there is ground to think that it might be of great service if used together with some powerful

[1] *The Lancet*, London, 1881, vol. ii. p. 369.

[2] Mr. Southam (*loc. cit.* p. 370); Mr. Godlee (*British Medical Journal*, 1880, vol. ii. p. 810); Dr. James J. Putnam (*Sequin's Archives of Medicine.* New York, 1881); Baum (*Berliner Wochenschrift*, No. 40, p. 595, Oct. 1878); Eulenburg (*Centralblatt für Nervenheilkunde*, April, 1880, No. 7); Schlüssler (in Wiet, *Contribution à l'étude de l'élongation des nerfs*, Paris, 1882, p. 83).

[3] Quoted by Wiet (*loc. cit.* p. 70).

[4] *Archiv für Psychiatrie und Nervenkranken.* Bd. x. Heft i. 1878, p. 284.

[5] *The Lancet*, London, 1881, vol. ii. p. 627.

[6] Quoted by Wiet (*loc. cit.* p. 72).

[7] *British Medical Journal*, 1879, vol. i. p. 933. Out of the number of cases I know of, that is twenty-three, there has been eight cases of recovery and fifteen failures.

internal remedies; 3rd. that, as pointed out by Dr. A. W. Johnstone,[1] it is essential to stretch all the nerves supplying the part, whose injury has caused the disease; 4th. that the operation should be made early and as high up as possible, if there is any suspicion of the nerves being inflamed near and at some distance from the wound, burn, or other injury; 5th. that stretching ought always to be strong enough to destroy the power of transmission of sensitive impressions in the nerve operated upon.

Nerve-stretching against an epileptiform affection.—The case of Billroth (already quoted) in which he pressed upon and rubbed a nerve has led Dr. Czerny [2] to stretch a nerve in a case of epilepsy. There was an aura starting from the hand and the ulnar nerve was stretched. There was no favourable effect. No hope of a cure can exist in cases of epilepsy by nerve-stretching, excepting those in which a clear peripheric cause exists.

Nerve-stretching against paralysis, anæsthesia and lepra anæsthetica.—A remarkable case of cure of paralysis, due to a fracture of the humerus, has been published by Muralt. The ulnar nerve was stretched and the cure rapid. In another case of traumatic paralysis the stretching of the ulnar and the median nerves led to a cure. A wound had caused paresis of some muscles and anæsthesia of the thumb and index and partly of the medius. One day after a slight stretching, sensibility had returned to its normal degree, and later on the muscles of the thumb recovered their action, but the extensor muscles remained paralysed.[3] In a case of slight wound having healed badly there was a paralysis with atrophy of some muscles of the hand. Slight stretching of the ulnar nerve was followed by a gradual return of muscular action in the paralysed parts.[4] In a case of paraplegia, with total loss of motion and sensibility, both sciatic and crural nerves were stretched on the two sides, and the patient, who for years had been confined to his bed, was able soon to go about on crutches, the paralysed limbs supported mechanically.[5] Unfortunately, no detail is given as regards the return of power and feeling, and it is a question whether the possibility of going about was not due simply to the immediate cessation of spasmodic movements. In a case of anæsthesia and paralysis of both lower limbs, from neuralgia on one side, Masing stretched the crural and sciatic nerves, and the patient ultimately was cured of the neuralgia, the anæsthesia, and the paralysis.[6] In lepra anæsthetica most remarkable effects of nerve-stretching have been obtained by Dr. Laurie [7] especially. He has treated thirty cases of that affection by that process. On all the patients there was a more or less favourable result; but for how long is not known. In the first case sensibility returned in the arm after the stretching of the ulnar, the hand became stronger and the thickening of the nerve disappeared. Dr. Laurie operated on the sciatic nerves and the two ulnars in one case, and obtained a return of movement and sensibility, especially in the upper limbs. Dr. G. Bomford [8] stretched both ulnar nerves in a case of great atrophy, paralysis, and anæsthesia from leprosy. There was a rapid return of movement and sensibility, the atrophy persisting, however.

Nerve-stretching in locomotor ataxy.—Carl Langenbuch [9] was the first who tried to ameliorate or cure that affection by that means. That first attempt deserves to be noticed somewhat at length:—

A man of forty had lightning pains and locomotor ataxy in the four limbs and had lost feeling, chiefly in the lower limbs. His pains were so great that Langenbuch decided to stretch the most attacked nerve, the left sciatic. The operation was performed on September 13. The pains in all parts supplied by that nerve disappeared at once. There was some

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[1] *The Lancet*, London, 1879, vol. ii. p. 892.
[2] *Revue des Sciences Médicales*, dirigée par Hayem, Paris, 1880, vol. xvi. p. 287.
[3] Blum, in *Archives de Médecine*, Janvier, 1878.
[4] Duplay, in *Revue des Sciences Médicales*, 1880, vol. xv. p. 690.
[5] *British Medical Journal* (from a German medical journal and without the name of the author), 1877, vol. i. p. 137.
[6] *Revue des Sciences Médicales*, vol. xiii., 1879, p. 727.
[7] *Indian Medical Gazette*, Sept. and Oct., 1878.
[8] *The Lancet*, London, 1881, vol. i. p. 329.
[9] *Berliner Klinische Wochenschrift*, 1879, No. 48, p. 709, and April, 1880, p. 236.

paralysis, which in a few days disappeared. On September 25 the two crural and the right sciatic were stretched. There was no more pain in the lower limbs. When the patient tried to walk, after a few days, he found that he had recovered some feeling, and it was ascertained that the ataxia had ceased. Later on he came to have the same operation performed on his arms, but died suddenly in a fit of epilepsy (?), when chloroform began to be given to him.[1] Esmarch has obtained a favourable result in a case of ataxy in which he stretched the brachial plexus. The pains and ataxia disappeared. Erlenmeyer,[2] in a bad case of tabes dorsalis, stretched the right sciatic nerve to the extent of six or seven centimetres. Ten days later the left sciatic was also stretched. There was no improvement of the various symptoms, except that the muscular power became greater in the legs. Erlenmeyer believes that he did not stretch the nerve enough in his two operations. Drs. Debove and Gillette [3] relate that in a very bad case of locomotor ataxy in the four limbs, one of the sciatic nerves was stretched, and that the result was most remarkable: the pains disappeared everywhere; sensibility returned; the muscular sense improved; the incoordination was diminished, but walking remained extremely difficult on account of an excessive atrophy of the legs. In a second case Debove and Gillette, chiefly against the pains which were intense in the two upper limbs, stretched the radial and median nerves on the right side. The pains almost entirely disappeared everywhere; the anæsthesia diminished in the left foot, the incoordination improved notably, and walking became possible without help. Dr. Sury Bienz [3] in a case of ataxia, with violent pains, obtained very favourable results from stretching of the sciatic nerve. Schlüssler [4] of Bremen, is said to have effected a complete cure, in a similar case, through the same means.

General features of nerve-stretching and its curative importance.—Some points clearly established by experiments on animals (chiefly mine and those of Tarchanoff) are strongly supported by clinical observation. *First*, stretching of a nerve acts on the nervous centres, and through them on more or less distant nerves. Most of the cases of nerve-stretching in locomotor ataxy especially show this; none as much, however, as the second case of Debove and Gillette, in which there was a great effect produced on the whole spinal cord by the stretching of the two nerves in one arm, and a more considerable amelioration in the foot and arm on the opposite side than in those on the side of the operation. Panas justly grounds the superiority of stretching over neurotomy on the favourable influence of the first operation on the nervous centres, in cases of neuralgic pains and spasms. It results forcibly from many facts that, even in cases when neurotomy is preferred, some pulling of the proximal end of the nerve (after the division) ought to be exercised. A proof of the superiority of stretching over neurotomy is found in a case I have quoted of Masing, in which stretching of one branch of the trigeminal has cured a neuralgia of almost all the branches of that nerve. It is especially in cases of nerve-irritations producing mischief through the nervous centres, that nerve-stretching is to be selected rather neurotomy. *Secondly*, experiments on animals show that there cannot be a considerable degree of nerve-stretching without a structural alteration of the nerve, rendering the operation equivalent to neurotomy. This is also proved to be the case in man. A clear conclusion flows out from this fact: it is that in cases of neuralgia, of painful or unfelt local spasms or twitchings, when it is important to produce anæsthesia or paralysis, for a time at least, it is well to draw considerably on the nerve, keeping in view that, if stretching is performed, as it ought to be, by means of a weight suspended to the nerve, there will be an alteration of tissue, sufficient to produce a loss of function, under a weight somewhat less than that which will break the nerve (see *ante*, the indications given of weights necessary to tear or to root out the principal nerves); *thirdly*, regeneration of nerves is more rapid in altered nerves after stretching than in divided nerves; this is established as well by experiments on animals as by facts observed in man.

In none of the various affections in which nerve-stretching has been used is it called for so much as it is in that incurable or almost incurable affection, *lepra anæsthetica*. The failure of other means renders the benefit obtained through nerve-stretching in that affection a very great blessing. In another kind of nerve-trouble, in which treatment generally fails also, *i.e.* in traumatic paralysis and anæsthesia,

[1] *Berl. Klin. Woch.*, April, 1880, p. 235.
[2] *Centralblatt. für Nervenheilkunde*, 1880, No. 21, p. 441.
[3] *Gazette Hebdomadaire*, de Paris, 1880, p. 823.
[4] Quoted by Wiet, *loc. cit.* pp. 139 and 140.

there has been what I may call wonderful successes obtained by nerve-stretching. Locomotor ataxy comes next in the series of affections in which our means of cure are limited, and in which, therefore, any new serviceable means of treatment must be welcome. Either because the cases of failure of amelioration by nerve-stretching have not been published, or because that means is really most valuable, we know almost only cases of improvement or cure (?), as the list I have given shows. Tetanus, by the same reasons, comes next. As regards cases of spasmodic tic, painless or painful, as in the epileptiform neuralgia, some distinction must be made concerning the kind of nerves on which stretching is used, and also the degree of stretching. The good effects obtained by pulling on a sensitive nerve (the branches of the trigeminal) seem to be much less than those given by the same operation on a motor nerve (the facial). If there is much pain, it is natural to act on a sensitive nerve; but it is, however, a mistake to think that there is a better chance of cure in a case of epileptiform neuralgia, to stretch a sensitive rather than a motor nerve. In that affection I have ascertained that in keeping the muscles absolutely motionless, by a considerable pressure on them, the attacks aborted completely; and there are many facts which I published long ago establishing that (as, for instance, in the pains that distension of the sphincter ani gives rise to in cases of anal fissure), muscles which tend powerfully to contract are the source of a very painful irritation of their sensitive nerves. It would be quite rational from my experiments and from many clinical facts (in several kinds of painful spasms of limbs as well as of the sphincter ani) to divide either the tendon or the body of the muscles seized with painful spasms in the epileptiform neuralgia, or, at least, to divide the trunk or some branches of the facial nerve (after stretching the trunk). As regards the degree of stretching in cases of facial twitching (painful or not), it ought to be such as to alter the structure of the nerve. This rule applies also to cases of neuralgia. Mere stretching is sufficient in that respect, and the process of squeezing, crushing of the stretched nerve, employed by Baum, ought to be rejected as worse than useless, as it can produce neuritis. It has been recommended in cases of stretching against sciatica to draw enough on the nerve to lift the limb from the operating table. Mr. J. Chiene[1] has perhaps justly denied the necessity of doing so. Still it is important to pull strongly enough (in cases of simple neuralgia) to produce at least a considerable diminution of sensibility, persisting for some weeks. The amount of force must be somewhat less in tetanus and locomotor ataxy.[2]

C. E. Brown-Séquard, M.D.

[1] *The Lancet*, London, 1878, vol. i. p. 904.

[2] In a good review of the whole subject of nerve-stretching, Messrs. Artaud and Gilson (*Revue de Chirurgie*, Paris, 10 Mars, 1882, No. 3, p. 221) give a detailed statistical account of all the cases they know of that operation. Their statistics can be summed up as follows: 1st, against neuralgia, 70 cases, out of which 48 were quite successful, 10 partly so, 6 were quite unsuccessful, and 6 were not sufficiently reported; 2nd, against contracture, 4 cases, of which 2 successful, 1 partly so, and 1 proved a failure; 3rd, against facial tic (not neuralgic), 5 cases, 4 successful, 1 a failure; 4th, against traumatic spasms and local convulsions, 1 cases, all successful; 5th, against peripheric paralysis, 5 cases, 1 successful, and 4 in which there was an improvement; 6th, against organic affections of the nervous centres, 16 cases, out of which 8 were cases of locomotor ataxy: 5 successful, 3 partly so, and 8 failures; 7th, against tetanus, 28 cases, of which 7 were successful, 19 unsuccessful, and 2 not reported.

LOCOMOTOR ATAXY.

ALTHOUGH locomotor ataxy comes more frequently under the care of the physician than the surgeon, yet in the early part of its course the symptoms are so equivocal, and so liable to be mistaken for those which belong to certain surgical diseases, that, for the sake of the differential diagnosis alone, a short description of this malady should have a place in every system of Surgery.

The symptoms observed in different cases on record are the following:—Strabismus, diplopia, amblyopia, amaurosis, ptosis, contraction of both pupils or only of one; shifting pains in different parts of the body, chiefly in the extremities; cutaneous and muscular anæsthesia and loss of sense of temperature; ataxy, or incoordination of voluntary movements; incontinence of urine and dysuria; loss of electro-muscular contractility in a greater or less degree; occasionally, but rarely, some paralysis of the first, fifth, seventh, eighth, and ninth cerebral nerves; spermatorrhœa, with loss of sexual power and desire; œdematous swelling of the joints, chiefly of the knees; cardiac and gastric disturbance; loss of tendon reflected movement.

All these symptoms are never associated together in any one case of locomotor ataxy; and the variety of ways in which they are grouped constitutes one of the peculiarities of the disease. Thus, to give a few practical examples, the symptoms are grouped in the following way, and made their appearance in the order of time in which they are mentioned.

Case I. Strabismus and diplopia; pains in the legs with numbness of toes; ataxy or unsteadiness of gait; numbness of fingers, followed by pains in the arms and unsteadiness of voluntary movements, or ataxy; incontinence of urine.

Case II. Pains with numbness and heaviness of legs; pains in abdomen and chest; ataxy; pains and numbness in hands and arms followed by ataxy; analgesia; incontinence of urine and dysuria, alternately; hæmorrhoids; loss of sexual power.

Case III. Hæmorrhoids, with pain and numbness in sacrum and perinæum; heavy forcing pains in rectum, with tightness and weight in abdomen. Subsequently pains in legs. Both pupils contracted to size of pin's head; ataxy of movement; loss of taste and smell; impaired sensation and motion on right side of nose; great numbness of feet and legs, and analgesia; numbness of fingers; 'quivering' of muscles; exalted reflex excitability of skin over feet and legs.

In many cases the pains in the limbs are for a period which can vary from a month to ten years or more, the only precursors of the other symptoms with which they are subsequently associated. They consist of two kinds—the one more or less dull, aching or gnawing, and frequently described by the patient as rheumatic; the other, more frequent and characteristic, more acute and lancinating, like electric shocks. The former are more continuous; the latter occur suddenly, in paroxysms which last from a few hours to a few days, and as suddenly disappear for an indefinite period. Even during the paroxysm the pain is not continuous, but intermitting, although it may recur in rapid succession at very short intervals, and may either fix on some particular spot, or fly from one part to another with the rapidity of lightning. The parts which most frequently suffer are the lower and then the upper extremities.

In other instances ocular disturbances are for a long time the only symptoms. These consist of internal or external strabismus, or amblyopia followed by amaurosis. In more than one-half of the cases of locomotor ataxy, paralysis of either the third or the sixth cerebral nerve, with diplopia, occurs during the first stage. It not un-

frequently makes its appearance quite suddenly—in a moment—for instance, on awaking in the morning. Sometimes it continues only for a few days, sometimes for weeks or months, and then disappears as suddenly as it came, to return, perhaps, at some future period. It may occur only at particular times of the day, during certain emotions, or after the eyes have been much fatigued; or it may persist uninterruptedly from the beginning to the end of the disease. Occasionally the strabismus is double, but more frequently it is limited to one eye. In other cases there is diplopia without a perceptible strabismus, when the patient looks in some particular direction. Not unfrequently there is also more or less ptosis and dilatation of the pupil. Sometimes one pupil is dilated while the other is contracted; and sometimes both pupils are reduced to a very small size, without any other ocular disturbance.

Amblyopia is occasionally one of the earliest symptoms of locomotor ataxy. It rarely disappears, or even remains stationary, but generally increases at a variable rate, and often terminates in amaurosis.

The ataxy, incoordination, or loss of power to control the voluntary movements, is an invariable and essential symptom. Occasionally it is first in the train of symptoms, but generally it is preceded, either by the peculiar shifting pains, or the ocular disturbances already mentioned. The disorderly movements occur under two different forms. First, they are generally manifested in the lower extremities, as simple unsteadiness of gait; the patient staggers or totters more or less, like a person partly intoxicated. At the same time he frequently complains of heaviness about the legs, of fatigue after walking a short distance, and particularly after standing. When he stands with his feet close together and his eyes closed, he sways about and would certainly fall if he were not supported. Before the disorder is far advanced, he may be able to walk alone while looking straight before him, or sideways on surrounding objects; but, at a later period, he cannot move without looking at his feet.

When the disorderly movement extends to the upper extremities, the patient is unable to dress himself, or button his clothes, to write, pick up a pin, or reach an aim with his hands when his eyes are closed.

As the disease advances, another kind of disorderly movement supervenes. This is of a jerking character, and arises from spasm of the muscles, which the will puts in motion, but is unable to control; for the patient has lost the power of regulating *the degree of their contraction.* Once excited by the will, the muscles contract spasmodically beyond the degree intended, and flex or extend the limb with a sudden and uncontrollable jerk.

These two kinds of incoordination are associated together in different degrees in different individuals; but the first kind is that which generally prevails in the early stages of the disease. At a later period, the second or spasmodic kind of disorder increases. All the voluntary movements are more or less hurried and precipitate. The patient seems to be walking upon springs; he proceeds with a kind of prancing gait, and brings his heels to the ground with a kind of kick. If he attempts to take hold of an object with his hands, he will probably thrust it from him by a spasmodic jerk of the arm.

The motor ataxy is usually accompanied, and occasionally preceded, by cutaneous *anæsthesia,* to a variable degree and extent. The fingers, toes, arms, and legs are the parts chiefly affected. Sometimes he can scarcely feel that he has any feet at all, or seems to be 'walking on air,' or 'on his ankle-joints,' or 'on his hip-joints,' when the numbness extends up the thighs.

Analgesia, or loss of sensibility to pain, is frequently experienced to a variable degree and extent; or painful impressions are conveyed to the sensorium with unusual slowness. In several cases seen by the writers, two, three, or four minutes elapsed before the patient experienced any sensation of pain in the part that had been pricked; and, in another, seen by Dr. Clarke, it was not till after the very long interval of *twenty minutes* that the patient, without being asked, complained of smarting in the part which had been pricked with a needle.

Like the strabismus, the disorders of the urinary organs are remarkable for the intermittence of their attacks. The dysuria and incontinence of urine frequently recur alternately at the same period of the disease.

Spermatorrhœa, followed by loss of sexual power, with or without loss of sexual desire, are among the early symptoms of the malady in a large majority of patients.

A valuable diagnostic feature of locomotor ataxy has been discovered by Professor Westphal. It is the loss of reaction in the leg when a blow is given on the tendon just under the patella.

Occasionally a very remarkable affection has been observed in the course of locomotor ataxy. This was first described by Dr. Charcot of Paris. The knee-joint is by far the most frequent seat of the disease, which occurs suddenly as an elastic œdematous swelling. The part is neither red nor painful, nor is there any constitutional disturbance or fever. Like the strabismus and urinary affections, it may last only a short time, or be prolonged and give rise to permanent deformities. In the latter case the bones and cartilages of the joint have been found diseased.

At an early period of the disease, before ataxy has made its appearance, the differential diagnosis may be exceedingly difficult. But whenever the peculiar flying pains suddenly attack an otherwise healthy person, there is danger of ataxy. If there is strabismus, it is accompanied by amblyopia; and when it is single, the amblyopia is on the corresponding side.[1] Even in cases in which other symptoms have been present, and in which the diagnosis was by no means difficult, operations have needlessly been performed on the eye by surgeons who were ignorant about this affection. It has often been mistaken for incomplete paraplegia.

Pathological anatomy.—In this disease the spinal cord is always altered in structure, and in one particular part. The alteration consists chiefly of a peculiar grey degeneration and disintegration of certain parts of the posterior columns, and secondarily of the posterior roots of the spinal nerves, of the posterior grey substance or cornua, and sometimes of the cerebral nerves. Pierret and Charcot [2] have shown that the part which is the real seat of the disease is the lateral band of the posterior columns close by the posterior cornua. Generally the posterior columns retain their normal shape and size, in consequence of hypertrophy of the connective tissue which replaces the lost fibres. Corpora amylacea and oil-globules of different sizes are also usually abundant. It is very common to find disintegration of the extremities of the posterior cornua, and sometimes Dr. L. Clarke has found the same kind of alteration in the more central parts of the grey substance. In the latter case the disease is of a mixed nature, partaking of the characters of locomotor ataxy and ordinary spinal paralysis.

Prognosis and treatment.—The prognosis is generally very unfavourable. It is chiefly at the first invasion of the disease that any marked benefit is to be expected from the use of remedies. Hence the importance of an early diagnosis. One of the chief objects is to protect the patient from cold and damp, and place him in an equable temperature. A good and wholesome diet, with wine or beer, is generally necessary. With regard to drugs, nitrate of silver sometimes exercises a very favourable influence on the disease. It may not only alleviate the pains, but diminish the incoordination. It should be first given in doses of one-eighth of a grain, gradually increased to one grain, three times a day, after meals. To prevent it from irritating the bowels or the bladder, it may be combined with opium, with cannabis indica, or with belladonna. For relieving the severity of the limb-pains, which so frequently disturb the patient's rest, there is nothing so efficacious as the subcutaneous injection of morphia (from one-sixth to one-half of a grain) together with atropia (from one-sixtieth to one-

[1] Dr. Hughlings Jackson states that the amaurosis of ataxy, as regards its ophthalmoscopic appearance, is unlike the amaurosis from disease of parts within the head. In amaurosis from intracranial disease the optic disc always shows evidences of recent or past neuritis, which is not the case in ataxy.—*Lancet*, January 10, 1865.

[2] Charcot, *Lectures on Diseases of the Nervous System*, Second series. *The New Sydenham Society*. London, 1881, p. 21 *et seq.*

thirty-fifth of a grain). These pains are aggravated by constipation, which, of course, must carefully be fought against. Dry-cupping along the spine sometimes affords decided relief. Sulphur baths have occasionally been of some service. Faradisation has generally been found to be rather injurious than beneficial, but the constant galvanic current has been used with the best results. The positive pole must be applied on the cervical part of the spine and the negative on the lower limbs or on the coccyx. A very powerful irritation of the skin of the lower limbs by a circular blister has proved successful in stopping the progress of the disease, and has sometimes done more. There is also some good to be expected from the use of atropia and the ergot of rye internally, and from slight applications of a white-hot iron on the limbs. As regards nerve-stretching we refer to the special article relating to that means of treatment.

J. Lockhart Clarke, M.D., 1870.

C. E. Brown-Séquard, M.D., 1882.

ORTHOPÆDIC SURGERY.

THE pathological nature of the affections relievable by surgical orthopædic treatment is various. They consist mainly of alterations, in form and movement, of the articulations belonging to the head, spine, and the lower and upper extremities. They spring—

1. From congenital influences, the varieties of club-foot, for example; malformations.

2. From influences acting during abnormal parturition.

3. From rachitis and allied constitutional states.

4. From derangement of the cerebro-spinal system, leading to paralysis or spasm and contraction.

5. From accidental injuries of articulations; undue pressure and strain; inflammation of joints or contiguous parts, whether or not succeeded by suppuration and its consequences.

Orthopædic surgery comprehends, therefore, a multitude of abnormal forms of the muscular, ligamentous, and osseous systems, of which some are treated elsewhere in this work. On the pathology of deformities arising from diseases of the joints, the reader is referred to the essay on those diseases; strabismus, at p. 124; malformations, with the SURGERY OF CHILDHOOD; burn-contractures, under PLASTIC SURGERY, &c. The affections which we have here to consider are principally those which can be remedied by tenotomy or osteotomy, by gradual mechanical extension, by sudden extension during anæsthesia, or by any or all of these means combined.

Before proceeding with the description of the individual distortions and their treatment, it will be well to consider the circumstances which give rise to contraction and deformity, and to inquire into the condition of the muscles, tendons, and bones which may render their division necessary. It is now a well-understood law of pathology, that if any part of the body, into the composition of which muscles enter, be maintained in a state of absolute repose, or be habitually kept in one position, so that the origins and insertions of particular muscles are constantly approximated, whilst the points of origin and insertion of other muscles are consequently proportionately separated, a shortened, contracted condition of the first set of muscles, and an elongated, weakened state of the second set of muscles, are produced. This is illustrated by what occurs during a simple fracture or other injury of an extremity. If the elbow, for example, be for any reason retained a few weeks in the bent position, the muscles on the flexed side of the member become stiff and contracted, and are only gradually restored to their natural mobility by active and passive exercises and use, whilst the stretched-out and weakened extensor muscles recover more slowly their full power of extending the implicated articulation. The state of things just described is aggravated when inflammation, exudation, suppuration, loss of cutaneous or more deeply-situated tissues, and consequent adhesions and cicatrices, interpose pain and physical obstruction to the restoration of complete mobility the greater duration of the disorder increases the probability that persevering or active remedial means will be required to obviate the shortening of one set of structures and the elongation and weakening of the opposite set. This shortening and contraction occur more rapidly during the earlier years of life.

The influence of paralysis in producing contracture varies according to the nature and extent of the seizure. A single muscle, as the sterno-cleido-mastoideus, the

tibialis anticus, or the external rectus of the eye, may be more or less completely paralysed; and the antagonist sterno-mastoid, the gastrocnemius, the peronei, or the adductor oculi, may become contracted. Or several muscles habitually associated in their actions may lose their power of voluntary contraction, as the extensors of the wrist and fingers; and the opposing muscles also habitually associated in their actions, viz. the flexors of the wrist and fingers, become relatively shortened.

Few paralyses occur without some degree of contraction ensuing as a consequence, either directly from the impairment of the balance of muscular activity, or from forced repose or maintenance of the part in a particular position.

The induction by abrupt spasm of a more or less rigid, more or less permanently contracted state of a part, is obvious and easily intelligible; but the spasm which produces many persistent deformities is not always of that active, prompt, or tonic kind which is illustrated by certain cases of non-congenital wry-neck and club-foot, but is usually more slow and progressive, as seen in many children's cases of foot-deformity. The contraction in congenital club-foot, and in the majority of congenital distortions can, we believe, be assigned only to a preternaturally excitable or tonic condition of the muscular fibres of the shortened muscles.

In many cases even when the shortened muscle has been set free by tenotomy, the morbidly excitable retractile disposition of the muscle often shows itself again after reunion of the divided part, and the cessation of employment of the mechanical or other means by which the affected muscle had been kept in an elongated state.

This contraction of certain muscles in congenital club-foot is therefore very different from the active powerful retraction which occurs in certain comparatively sudden non-congenital cases, and in which the will of the individual is powerless to effect an improved condition of the limb. In congenital club-foot, and in analogous gradual non-congenital talipes in which paralysis does not exist, if the child is old enough to exercise volition, the affected muscles may be subservient to the will, although volition is incapable of willing entire relaxation of the contracted muscles. Thus the contraction in non-congenital non-paralytic talipes, the early stage of which we are able to watch, throws light on the congenital affection, the early stage of which is hidden in the uterus. In non-congenital cases of months' or years' duration, induced by cerebro-spinal affection or by reflex (?) disorder, the vital abnormal spastic contraction co-exists after a time with secondary accommodation or adaptive structural change. We sometimes, however, before structural change has taken place, have an opportunity of witnessing that, although the patient walks with the heel, for example, much elevated, yet when he is seated, even with the knee extended, he can voluntarily bend the ankle, contact of the sole with the ground exciting abnormal contraction. Further light is thrown upon the nature of the contraction in congenital club-foot by the observation that, during sleep, even in very young infants, the affected foot can be more readily straightened; also that, like as in certain cases of adult hemiplegia, when the child yawns and stretches out the limbs, the inversion of the foot often disappears. This observation would show, that whilst in the ordinary state of the infant's nascent volition the adductor muscles (the tibiales) overpower the abductors (the peronei) and invert the member, the act of yawning, with its complicated reflex activity of inspiratory muscles, and of associated muscles in the extremities, neutralises the peculiar disturbance of muscular activity on which talipes varus depends.

It seems as if in congenital club-foot and analogous distortions a stimulus or irritant were present in the medulla spinalis, acting upon certain ganglionic cells there, which keeps the affected muscle in a state of tonic contraction, yet not sufficient to neutralise the stimulus of the will within the limits of movement permitted by the structural shortening of the member. Many non-congenital spastic contractions appear allied to the condition which prevails in some states of chorea, in which, when the will would permit or cause contraction or relaxation of a particular muscle, an involuntary influence excites contraction, interferes with, and frustrates the voluntary effort. In more intense spasmodic contractions the will is entirely overpowered before structural shortening supervenes to effect the same end.

Secondary changes.—From whichever of the above causes a constantly contracted state of an articulation or limb may have proceeded, the state of things consisting of the inability of the individual to put the part, by the action of the will, through all its proper movements is called a deformity. But if the patient by means of his own hands, or if the surgeon, can overcome the contraction, and put the affected part through its proper movements, no deformity is in reality seen to exist. Positive deformity may early exist, when original disease of the joint has, besides producing contraction, ended in more or less considerable alteration in form and structure of the articulation. But almost equally serious (secondary) deformity may ensue through the influence of the now ill-regulated muscles of the joint, especially when these act upon tissues impaired by disease—the production of sub-luxation, for example. In the lower extremity, the effects of the weight of the body being borne upon the member in improper directions is a very important cause of secondary deformity, adding greatly to the obstacles to restoration. Thus a not severe case of congenital club-foot, remediable in point of form in a few weeks before walking has commenced, may subsequently require treatment of months or of years; or, from the deteriorating cause above mentioned, be rendered irremediable.

We may now pass to the consideration of the means employed in orthopædic surgery for the rectification of deformities. This department of practice avails itself of much that is common with general medicine and surgery.[1] Special orthopædic means are, the relieving of the shortened parts by the employment of mechanical instruments, or mechanical power exerted by the hands of the surgeon or assistants, sometimes with the aid of the benumbing influence of chloroform, and by division of one or more of the contracted muscles, tendons, fasciæ, and bones.

Tenotomy, myotomy.—In this operation the necessary relaxation of muscular resistance, and of accompanying structural shortening, is effected by severing the muscle almost invariably at its tendinous portion. The principles laid down by Delpech for the performance of this operation are followed in the present day. It is remarkable that Delpech never carried out his own principles.[2] Astley Cooper,[3] speaking of palm and finger contraction, states that he divided the contracted bands 'with a pointed bistoury, introduced through a very small wound in the integument. The finger is extended, and a splint applied to preserve it in the straight position.' Here we have essentially the subcutaneous method of operation unequivocally enunciated by that distinguished surgeon. Stromeyer took up the matter where Cooper and Delpech left it, and first applied it to the Achilles tendon (1831), and by his labours and writings caused its diffusion throughout Europe and America. Many alterations in the mode of applying these principles have been made since the original labours of Delpech and Stromeyer. Various knives for severing tendons (tenotomes), and a great variety of mechanical extension apparatus, have been devised. In this place only the means in most general use in this country will be described.

In describing the several distortions no nosological order will be adopted. We will commence with congenital club-foot (talipes varus congenitus), because it is one of the most common distortions which the surgeon has to treat, and because it has formed the basis of extensive pathological and therapeutical research, and will best illustrate the principles upon which the management of other distortions should be conducted.

Congenital Club-foot (Talipes varus congenitus).

We may state at the outset, in order to avoid the confusion introduced by late writers, that we employ the words congenital varus to signify the distortion which has from the earliest times been designated varus, or club-foot, the term equino-varus having been subsequently introduced to designate the non-congenital combination of equinus with varus. Some moderns, without prefixing congenital or

[1] Constitutional, medicinal, and dietetic treatment, exercises, gymnastics, inunctions, &c.

[2] See the history of the treatment of club-foot and division of tendons, in a *Treatise on Club-foot and analogous Distortions*, by the Author. London, 1839.

[3] *On Dislocations and Fractures of the Joints*, 6th edition, 1829, p. 476.

non-congenital, as the case may be, have termed both of these distortions equino-varus. It is true, as we have always stated, that both the congenital and non-congenital forms are compounded of varus and equinus, but it is almost as desirable in practice to adhere to the word varus in surgery as to the word calomel in Materia Medica.

Anatomy of club-foot.—Former opinions on the anatomy of club-foot may be advantageously passed over.[1] In 1837, and subsequently, the author laid down the essential characters of the anatomy of club-foot.[2] The subject has since been carefully and successfully studied by Mr. William Adams.[3] The general result of observations of this matter is the confirmation of the opinions emitted by the author in 1837 and 1839,[4] that club-foot consists of a three-fold alteration of the form and position of the foot, the heel being elevated, the toes turned in, and the internal margin of the foot raised from the ground, owing to abnormal action and shortening of the principal, if not of all, the muscles of the inner and back part of the leg. In at least the severer forms, those in which the sole is much contracted, the plantar muscles participate in the primary affection. The ligaments, fasciæ, and integuments on the contracted side of the member are also shortened, whilst the similar tissues on the opposite side are elongated and weakened. These passive tissues follow the fortunes of the active organs—the muscles, on which they are in the main dependent; and become thus secondarily affected. The bones, before and after ossification, suffer in proportion to the intensity of the muscular contraction, and probably in proportion to the earliness of the period of uterine existence at which the distortion commenced; and especially in proportion to the period that elapses after birth, during which the passive osseous structures remain at the mercy of the active muscular agents. The bones further suffer as age advances, by bearing the weight of the body in an improper direction.

The departure from the normal form and relation of bones may be divided into—

1. Primary.

a. The changes especially affecting the tibio-tarsal joint.

b. The change of relation of the anterior bones of the tarsus, as regards the astragalus and os calcis.

2. Secondary, or those induced after birth, by spontaneous aggravation of the deformity, and by pressure upon the parts through walking in an improper manner.

The anatomical changes of bones in varus of practical moment are due to the state of extension of the os calcis, taking with it the astragalus, through which the posterior extremity of the os calcis is more or less closely approximated to the posterior surface of the ankle-joint; and the anterior portions of the articulating surfaces of the trochlea of the astragalus are projected from the ankle-joint in front. Owing also to the forced inversion of the entire front of the foot, the external malleolus is thrown backwards towards the posterior tuberosity of the os calcis, and the anterior extremity of the astragalus slightly inclines towards the inner margin of the foot. The forced elevation of the posterior part of the foot (calcaneum and astragalus) is common to talipes varus and to talipes equinus; but the characteristic peculiarity of varus is the displacement of the remaining bones of the tarsus inwardly to the extent that the navicular bone quits the astragalus, often touching the internal malleolus, with which it frequently acquires a new articulating surface. The cuneiform and cuboid bones accompany the navicular. Moreover, in severe cases the cuneiform, cuboid, and metatarsals, with the phalanges, are drawn backwards, limiting the space of the plantar region.

The changes of bones induced by improper walking, improper pressure and

[1] See *On the Deformities of the Human Frame*, by W. J. Little, pp. 271 *et seq.* London, 1853.

[2] *Dissertatio inauguralis de Talipede Varo.* Berlin, 1837.

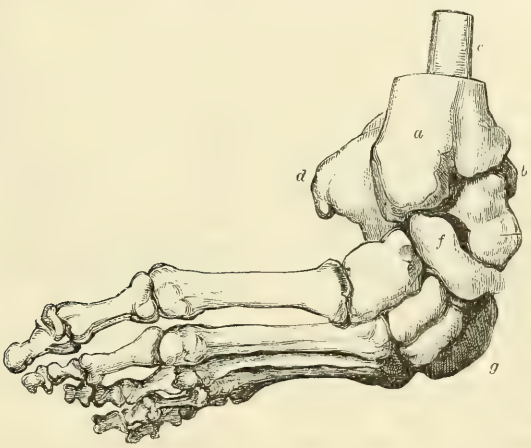
[3] *Medical Times and Gazette*, 1852; *Transactions of Path. Soc.*, 1856.

[4] *Treatise on Club-foot and analogous Distortions.* London, 1839. A large number of treatises on club-foot have appeared since 1837, few of which contain any fundamental researches into the anatomy of varus.

bearing against the ground, by which also sometimes inflammation and ulceration of soft parts are occasioned, do not properly belong to simple uncomplicated club-foot. Only when these injuries are considerable do they affect the results of treatment.

The shortening of the ligaments, fasciæ, and integuments on the posterior and internal aspects of the member may be observed when, before or after operation, attempts are made with the hand to rectify the deformity. In severe cases, much resistance to cure is offered by the posterior ligament of the ankle, the deltoid, the calcaneo-scaphoid, the superficial and deep plantar ligaments. The share of resistance offered by the deltoid, for example, is well shown when dissecting severe infantile varus. The author, following Mackeever, has observed that when the deltoid ligament is severed and the navicular bone is liberated, a marked facility of replacement is evinced.[1]

Fig. 15.—Severe adult congenital Varus, viewed from the front and inside.



a, the tibia, cut down in order to show the relatively posterior situation of the fibula; *b*, the externa malleolus; *c*, the fibula; *d*, the posterior extremity of the os calcis, drawn abnormally inwards; *e*, the astragalus, unduly prominent on the dorsum of the foot; *f*, the navicular bone in contact with the internal malleolus; *g*, the cuboid, its proper superior surface applied to the ground.

The general direction of the structures involved in the distortion is much altered. Thus, the leg-bones are often inwardly rotated from the knee-joint. The surgeon should not expect to find the tendons occupying their normal relations. Those passing over the front of the ankle-joint are deflected inwardly, whilst the posterior tibial tendon is deeply situated, owing to the incurvation, and to the backward dragging, and elevation of the anterior part of the foot.

Ætiology of congenital club-foot.—The primary cause of talipes varus congenitus has been already touched upon, p. 228. It consists in contraction of certain muscles, apt to be accompanied or followed by structural shortening,[2] and by fibrous and adipose degeneration of them.[3] Until the researches of Rudolphi, it was held that club-foot, as well as other distortions and malformations, were the consequence of some 'occult influences,' lusus naturæ, maternal imagination, and intra-uterine pressure. An occasional effort is made to revive the last of these theories, that of intra-uterine pressure. It has been elsewhere shown[4] that accidental mechanical causes do sometimes act upon the fœtus, giving rise to easily recognisable conditions, *e.g.* fissures, clefts, intra-uterine fractures, amputations of members from constriction by abnormal bands or by the umbilical cord; and sometimes the co-operation of pressure by the uterine walls and pelvic bones may be surmised.

[1] Colles, *Dublin Hospital Reports*, vol. i. p. 184. [2] Little, *loc. cit.*
[3] Cruveilhier, *Anat. Pathol.*; W. Adams, *Pathol. Trans. loc. cit.*
[4] *On Deformities of the Human Frame*, pp. 256–314.

Further arguments in favour of the belief that ordinary congenital club-foot is caused by some derangement of the cerebrospinal centres and dependent nerves, as opposed to the theory of its dependence upon primordial malformation or upon pressure of the walls of the uterus, may be thus stated :

Club-foot often co-exists with evident derangement of the nervous centres, as in acephalous, hemicephalous, and spina-bifida subjects.

Club-foot occasionally co-exists with an analogous distortion of the upper extremity, club-hand, in which the muscles contracted are the anatomical analogues of the parts contracted in the lower limbs. Now if it be admitted that the external configuration of double club-foot may suggest to the unphysiological and unpathological observer, the idea of one of the feet having overlapped the other in such manner that the uterus, *supposing* the liquor amnii to be deficient, has compressed the two feet into the form in which we see them, this explanation does not apply to the club-hands, which bear no such form as can be reasonably attributed to pressure of the uterine walls. Moreover club-foot often exists in one foot only, and the uterine-pressure theory does not explain why one foot escapes. This theory is still less applicable to the highest grade of club-foot, in which the great toe is more approximated to the inside of the leg than pressure of the uterus will explain ; whilst the opinion of disturbed action of the muscles before the articulating ends of bones can restrict their action, affords an intelligible explanation.[1]

Club-foot is met with in fœtuses before the fourth or fifth month of gestation, at which period the liquor amnii is relatively so large as to exclude the idea of uterine pressure consequent upon *supposed* deficiency of that fluid.

We have traced congenital club-foot on the paternal side even through four generations, the male infant—the father, the grandfather, and the great-grandfather. If it can be plausibly maintained that club-foot is due to the influence of uterine pressure, deficiency of liquor amnii, pressure of pelvic bones, and its repetition through successive generations, this influence could only be propagated through the female side. We cannot admit uterine influence in hereditary propagation of varus through an uninterrupted succession of male parents.

A comparison of club-foot with the distortions which occur after birth, unmistakably from diseases of the nervous system, tends to prove that congenital and non-congenital club-foot spring from analogous causes. Distortion after birth, from altered innervation of muscles, is more common in the lower extremities, and especially in the feet, than in any other part of the frame. Club-foot is also the most common distortion before birth. After birth, talipes varus, in consequence of cerebrospinal affection, is more common than talipes valgus ; before birth also, varus is more common than valgus. After birth, foot-deformity, from disease of the nervous system, attains oftener a higher grade on the left than on the right side. This is equally the case with congenital club-foot. Some other agency than accidental uterine or pelvic pressure is required to account for these analogies ; they cannot be regarded as mere coincidences.

Grades of congenital talipes varus.—It is convenient for practical purposes to divide congenital club-foot into three degrees of severity : the slightest, that in which the position of the front of the foot when inverted is such that the angle formed by it with the inside of the leg is greater than a right angle, and in which the contraction is so moderate that the toes can easily be brought temporarily by the hand of the surgeon into a straight line with the leg, and the heel be depressed to the natural position. The second class includes those in which the inversion of the foot and elevation of the heel appear the same or little greater than in those of the first class, but in which no reasonable effort of the surgeon's hands will temporarily extinguish the contraction and deformity. The third class comprises those in which the contraction of soft parts and displacement of hard parts reach the highest degree, so that the inner margin of the foot is situated at an acute angle with the inside of the leg, sometimes is even almost in contact with it.

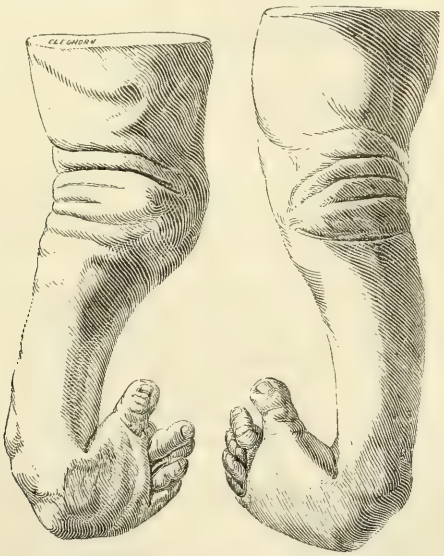
[1] See *Trans. of the International Congress,* London, 1881. Little, vol. ii. p, 412.

Cases of the first and second grades may be respectively converted into the second and third grades by delay in the application of remedies, and by the effects of improper treatment.

Fig. 16.—Congenital infantile Talipes Varus, of medium severity. Reproduced from *Club-foot and analogous Distortions*, 1839.

Treatment.—The indications are to overcome the shortening of the muscles, ligaments, fasciæ, and integuments on the contracted side of the member; to direct the bones into their proper position; to educate the patient's voluntary use of the parts;

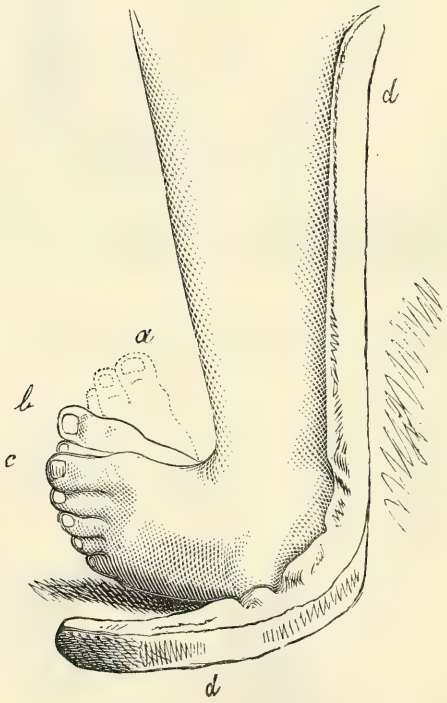
Fig. 17.—Most severe grade of infantile congenital T. Varus. The great toes of this patient frequently touched the inside of the leg. The woodcut was taken from a plaster of Paris model. The weight of the plaster which was allowed to intrude between the toes and the legs kept these parts asunder, in order to show the extent to which the distortion was diminished when the surgeon attempted gently with his hand to restore the natural form. Reproduced from *Deformities*, 1853.



to give strength to the muscles and ligaments on the elongated side of the member, and to combat the tendency to relapse.

A few slight cases may from the day of birth almost be relinquished to the rubbings and manipulations of the nurse; some require to be lightly bandaged on a strip of tin or firmer metal, bent to a right angle, and properly padded; others require support not only beneath the sole, and against the back of the leg, as when a simple bent strip of metal is employed, but need lateral support or pressure against the internal margin of the foot, as by the application of a tin splint. In the use of this and similar contrivances to be found at the different surgical instrument-makers, the essential point consists in applying the smallest amount of pressure compatible with maintaining the apparatus on the limb, not endeavouring at once either to force the part straight or even to make the tender infantile foot accurately fit the apparatus, but rather, if the apparatus selected admits of adaptation, to adjust it to the foot in a somewhat improved position. Practitioners unacquainted with the details of

Fig. 18 represents a case of congenital Varus being gradually conducted to a state of equinus.



The dotted outline, *a*, represents the extreme degree of inversion and elevation of the internal margin, to which the foot is occasionally drawn by the anterior and posterior tibial muscles; the position at *b* represents the ordinary quiescent condition; *c*, the position to which a slight touch of the surgeon's hand brings it; *d*, *d*, represents a flexible, metal, padded splint, bent almost to the shape of the foot as represented at *c*, applied along the outer side of the leg, and as near as can be along the outer margin of the foot, intended to be secured in position by a gently applied roller bandage.

management of these cases are surprised to discover how small an amount of pressure suffices in young infants rapidly to improve the form and flexibility. The splint should daily once, or oftener, be removed to ascertain that undue pressure has not been used, to replace it when loosened by the movements of the child, and to improve the position as often as practicable. No unnecessary loss of time should be permitted during this process, as at first the foot rapidly relapses to its most distorted condition. After the part has been straightened, the parent or nurse should be taught to remove the splint and effect gentle manipulations two or three times daily.

If at the expiration of the fourth week distinct contraction of the tendons remain perceptible in spite of the assiduous efforts to overcome the deformity by manipulation, frictions, and steady but gentle employment of splint and bandage, or if

benefit proportionate to the attention bestowed be not realised, or if the case unequivocally belongs to the second or third degrees of varus, the aid of tenotomy will be required to effect restoration. If the surgeon should entertain doubt whether the time for operation have arrived, he may be determined by the observation whether, on holding the foot in the normal position, it springs vigorously back into the abnormal one as soon as the pressure of the hands is removed. In unequivocal cases of the second and third degrees he may, in most cases, decide affirmatively at the moment of birth on the absolute necessity of future operation; and when operation is indispensable, the earlier the period at which it is performed the better. Mr. Stromeyer Little has operated within twenty-four hours after birth with rapid and permanent success. Our practice of late years has been to operate as soon as convenient during 'the month.' The surgeon, when deciding on the necessity of operation, must not be guided solely by the external configuration, but by the amount of firm resistance opposed to restoration by the depth of the furrows existing in the sole and behind and above the heel, and by the degree of tension of the integuments about the internal malleolus. The deep clefts or furrows in question denote intensity of contraction of muscles, and closer adhesion than usual of integuments and fasciæ to the subjacent soft structures and bones. They probably denote also that the deformity dates from an early period of uterine existence. Even atrophy, the usual concomitant of contractions of long duration, is already present in severe club-foot of new-born children, and is a measure of the length of time the muscles have been contracted and exposed to structural shortening and possible degeneration.

The principles of treatment of congenital club-foot are here summarised.

1. Whether the case promises favourably for mechanical treatment only, or needs, as the majority of cases do need, operative interference, commence the treatment *as soon after birth as practicable.*

2. Completely reduce the distortion from the state of a compound one (varus) to the simpler form (equinus), by first curing the inversion of the foot, and the tendency to involution of the sole.

3. Avoid the slightest undue pressure upon prominent points of the leg and foot, by careful padding of the hollow parts, and by using only gentle pressure with any bandage. Avoid obstruction of the returning blood from the limb.

4. Remove splint and bandage daily, practise gentle movements of the foot in the desired direction, endeavour to prevent the part remaining for an instant unsupported and liable to fall back into the deformed position, until it is found that the foot, on removal of the bandage, retains a perfectly good position and flexibility.

5. Never permit the child to be placed on the feet, or to walk until the form and the range of movement are complete, whatever may be the age of the patient.

Be convinced that by carefully following these recommendations, the healthy child will, before the age of thirteen or sixteen months, stand and walk without instrumental aid; that the muscles of the leg will be fairly developed, and a by-stander have difficulty in discovering that any distortion formerly existed.

Nature of the operation.—The essential character of congenital talipes varus being a state of abnormal elevation of the heel, and inversion of the front part of the foot by undue muscular contraction, the operative interference required consists of the division of the tendons of those muscles which are mainly, if not exclusively, concerned in the production of the deformity, viz., the tendons of the anterior and posterior tibials and the tendo Achillis. In average cases these three tendons may be divided at one operation. In severer cases the operation should invariably be divided into two parts, the first consisting of the section of those structures which contribute to the inversion—the tibiales tendons; and where the sole is much contracted with a strong prominent band felt at the inner edge of the plantar fascia, that band may be included in this portion of the operation. The division of the plantar textures and elongation of the sole may in severe cases advantageously precede the section of other structures. The tendo Achillis may in such cases be severed in three or four weeks; in adults two or four months later; the inversion having, in the interval,

been overcome. The value of this proceeding, first recommended by the author,[1] consists in the os calcis, when the tendo Achillis is left intact, offering a *point d'appui*, or resisting point, from which the surgeon, during the mechanical after-treatment, is enabled to stretch out and unfold the contracted involuted sole. If this division of the operation into two or three parts is not observed in bad cases, incomplete recovery may result, the sole remain contracted, and the individual walk unduly on the heel and outside the foot, the range of motion of the point of the foot being deficient,—in short, a secondary talipes calcaneo-varus be produced. This secondary deformity is always overcome with difficulty, sometimes it is irremovable. Not unfrequently the patient is left with half or more of the original deformity, requiring that the surgeon recommence the instrumental treatment, devoting himself, as already stated, at first exclusively to the obtainment of eversion of the front of the foot and unfolding of the sole, before he attends to the lowering of the heel.

In a few adolescent and neglected adult cases of congenital equinus and varus, even the peronei may need division, these muscles having become, from protracted duration of the deformity, tensely contracted and considerably shortened.

The following is the mode of dividing some of these tendons, and the instruments which we have introduced as the most appropriate for the purpose. When it is decided in infants a few days old to rectify simultaneously the inversion and elevation of the heel, the operation is more quickly and conveniently done by taking the three tendons in the following order; viz. the posterior tibial, the anterior tibial, and the tendo Achillis. Section of the posterior tibial is best performed by placing the child on a table of convenient height, on its back, inclined towards the limb to be operated on. This should be thoroughly rotated outwardly, resting upon its outer side, whilst a competent nurse holds the child's hands and the opposite leg out of the way of the surgeon. An assistant, having a few small dossils of lint, a bandage, and the necessary knives within reach, takes his place by the side of the patient, and holds the thigh and knee of the limb to be operated on with one hand, being prepared with the other to hold firmly or adduct the foot as may be required. The operator, when about to sever the left posterior tibial, seats himself in front, takes the foot in his left hand, and endeavours to feel the slight prominence of the posterior tibial tendon with the left thumb; during the time he either abducts the foot with the right, to put the tendon on the stretch, or takes advantage, during the spontaneous movements of the infant, to observe where the tendon is thrown into palpable relief.

When, however, the surgeon cannot feel the tendon, it is practically quite sufficient to make out the inner edge of the tibia, about a finger's breadth above the lower end of the inner malleolus; or should there be any difficulty in defining this ridge of bone in consequence of the fatness of the limb, the careful insertion of the knife *exactly midway between the anterior and posterior borders of the leg*, on its inner aspect, will be an exact guide to the position of the tendon, not forgetting, as anatomy teaches us, that an incision made a little in front of this line might wound the internal saphena vein and nerve; and if made behind it would run the risk of dividing the flexor communis digitorum instead of the tibialis posticus; or the knife might even pass posterior to the former tendon, and, if carried deep enough, might wound the artery and nerve without touching any tendon whatever.

Having thus determined the situation of the posterior tibial by one or all of these methods, a sharp-pointed knife is passed through the skin at about a finger's breadth above the inner malleolus, according to the age of the child. It must be made to penetrate steadily down to the tibia, *perpendicularly to the surface*, to a depth varying from a quarter to half an inch. In doing this, it is necessary to be quite sure of sufficiently opening the fascia covering the posterior tibial and common flexor tendons; otherwise, when the probe-pointed knife is passed in (as will be described in the next stage of the operation), it may either hitch against this dense unyielding structure, or glide over its surface behind the deep layer of muscles, instead of passing through the opening in front of them.

[1] *Lancet*, May 25, 1839.

In order, therefore, to accomplish the *free division* of this fascia of the leg close to its insertion into the edge of the tibia, and likewise the proper sheath of the posterior tibial tendon beneath, the sharp-pointed knife should be passed to the depth above recommended; the handle must then be elevated so as to depress the point of the blade; that is to say, the instrument should be used as a delicate lever, the centre of motion being the skin, which may be pressed upon gently by the back of the knife; and in this way an opening of the requisite size can be made in the fascia at the bottom of the wound, without enlarging the external aperture.

Having thus far accomplished the operation, the sharp-pointed knife is withdrawn, and a probe-pointed one is to be passed into the puncture through the skin, superficial fascia, layer of adipose tissue, deep fascia, and lastly the proper sheath of the tendon, and be now inserted a little further in, so as to get well between the posterior tibial and the tibia. When satisfied from the sensation communicated to the knife that the bone is on one side and the tendon on the other, all that remains to be done is to turn the edge towards the tendon, giving the knife a slight cutting motion, while at the same time the assistant firmly abducts and depresses the inner border of the foot.[1] The surgeon accustomed to tenotomy now commonly effects division of the posterior tibial tendon in very young, even stout, infants with a single sharp pointed convex-edged scalpel, instead of performing the operation *à deux temps*. With the latter operation the surgeon is less likely to divide more than he desires.

As soon as the peculiar jerk of something having suddenly yielded is detected by the assistant, he should immediately relax the foot, and apply a dossil of lint over the wound, holding it there with the forefinger during the division of any other tendons. If, as has happened, the artery is supposed to be cut, either from the escape of florid blood or from the blanched appearance and reduced temperature of the foot; or one of the large superficial or deep-seated veins, indicated by the escape of black blood, it will only be necessary to apply instantly a graduated compress, and to roll with some firmness a bandage upon the foot and ankle. This, however, may require to be loosened if the colour of the toes shows any indication of undue pressure. Under ordinary circumstances, operations are bloodless if the surgeon and assistant be experienced and prompt. The puncture unites within forty-eight or seventy-two hours if the part be kept at rest, and a due temperature maintained. If the operator is not ambidexter, he will find, in the operation for dividing the posterior tibial tendon of the right limb, that he had better stand on the left side of the patient with his back to the patient's face, whilst the assistant sits down in front, and holds the thigh with one hand while he steadies the toes with the other.

Taking, then, the mesial line on the inner aspect of the leg at about three-quarters of an inch above the inner malleolus as the true position of the tendon, the sharp-pointed knife is to be inserted perpendicularly, with its back towards the sole of the foot. It is thus made to divide the skin and deep fascia in the same way as was explained when cutting the left posterior tibial tendon. After this instrument is withdrawn, the probe-pointed knife may now be used to finish the operation, which in all other respects agrees with the section of the corresponding tendon on the opposite side of the body. The long flexor of the toes, owing to its proximity, is often partially or wholly severed at this operation on the posterior tibial.

Weis and Velpeau divide the posterior tibial tendon at its insertion into the navicular bone, the knife being inserted so as to meet the tendon about an inch (in the adult) below and in front of the inner malleolus. This plan is inapplicable to infants. In adolescents and adults this tendon is usually so prominent to the eye and touch above and behind the internal malleolus, that it is an easy matter to sever it by inserting the point of a narrow straight scalpel at the posterior edge of the tendon, directing it forwards between the tendon and tibia, so as to divide it without risk of injury to the posterior tibial artery or the internal saphena vein. It is unnecessary to give particular directions for division of the plantar fascia when

[1] We have seen more than one straight sharp-pointed bistouri caché used instead of two separate knives. The best of these was in the hands of Dr. Dick.

needed, those given respecting operations on other tendons being amply sufficient. The direction of the knife should be from without inwards, *i.e.* from the external margin of the foot towards the internal margin.

Division of all the plantar tissues from without inwards, sometimes with open wound, latterly subcutaneously, from without inwardly has been practised. In this wholesale section, guided by Jules Guérin's experiments on the safety with which subcutaneous sections may be made in animals, the fasciæ, muscles, tendons, nerves, and vessels down to the under surface of the tarsal bones have been severed. Experience shows that this proceeding is not required in adolescents and still less in infants and young children. In most severe adult cases, so great is the difficulty of cure that anything short of mutilation is applicable. In inveterate elderly adult cases restoration to *perfect* form and movement is found impracticable, mutilation in the shape of excision of a considerable wedge of the tarsal bones, or even a Pirogoff operation, may be done in the adult where the sufferer demands riddance from deformity at any price.

The division of the anterior tibial tendon in talipes varus should follow the section of the posterior tibial; the patient being in the same position, and the assistant still holding the limb, and pressing his finger upon the lint covering the puncture already made above the ankle. The operator should feel for the most prominent part of the tendon over the joint, somewhat nearer the malleolus than in the normal foot, and insert a sharp-pointed knife, with its flat surface towards the outer edge of the tendon; and having passed it well beneath, he should turn the sharp edge towards the tendon, whilst the forefinger of the left hand is pressed gently over the part, to warn him of the approach of the knife to the surface. The assistant, who has been steadily abducting the foot during the operation, gradually relaxes his endeavours as he feels the tendon yield; and so soon as he perceives the distinct snap which is the result of its complete division, he should immediately relax his hold, and apply a small dossil of lint over the puncture.

Division of the tendo Achillis is accomplished after turning the infant over on the abdomen. Whilst an assistant endeavours to bend the ankle, the surgeon introduces a small straight tenotome through the integuments from behind forwards at the side of the tendon. As soon as the point of the instrument is judged to have reached the anterior surface of the tendon, it is passed in front of it; the cutting edge is then directed to the tendon, severing the tense cord by one or two movements of the blade against it, and without wounding the integuments, except by the puncture of entry. The assistant should carefully relax the pressure he may be exercising upon the foot in proportion as he feels the part is cut through.

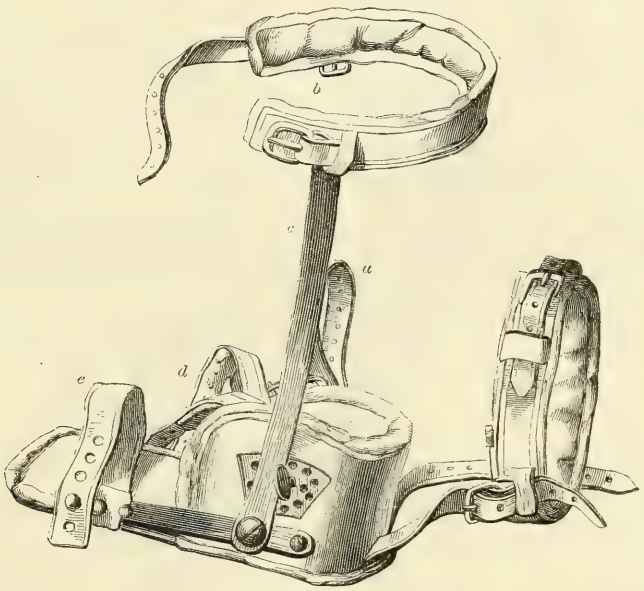
These operations, when properly done, occupy not more than a few seconds each, and are usually absolutely bloodless. Much has been written concerning the danger of wounding the posterior tibial artery. I have only once witnessed any trouble from the circumstance. This accident occurred to a former colleague. Ligature of the vessel on account of a small filbert-size aneurism was required the third week after the operation. In that instance the wound in the vessel would have probably healed without aneurism if the surgeon had not too soon after the accident incautiously removed the bandage and abducted the foot. When injury of the vessel is suspected or known to have occurred, the removal of the bandage at the commencement of the mechanical after-treatment should be delayed one or two weeks and be proceeded with using extreme gentleness.

A pasteboard or other splint, previously moulded to the form of the contracted part, should be employed immediately after the operation, to ensure quiet, and favour healing of punctures.

Apparatus required after operation.—The metal splints already reccommended for cases relievable without operation are equally applicable after division of tendons. Three days after operation, one of these splints, not much straighter than the affected foot, should be selected, or if a splint capable of being adjusted be used, it should be set at an angle or in a direction that the child will bear without complaint. In patients above the age of two or three months, a more elaborate and effective

apparatus may be employed, when the pecuniary circumstances permit it. The woodcut, fig. 19, represents the lightest, the most effective, and the most inexpensive of the more elaborate apparatus constructed for the purpose. The perpendicular lever and the toe-spring are derived from Scarpa's shoe; but as Scarpa's apparatus contains no contrivance for depressing the heel, but relies simply on the effect of the weight of the body acting during locomotion, the author has introduced the movable thumb-screw, capable of being inserted into any required hole of the quadrant shown as above. This is an improvement upon the male and female screw, and the double-acting ratchet-screws often used for the purpose. The simple arrangement of a movable thumb-screw has, in addition to lightness, the advantage of permitting mobility of the ankle in the direction of bending—a circumstance of much importance. No other apparatus which the author has seen possesses the advantages of permitting perfect freedom of motion of the ankle during exercise or as much freedom as the surgeon may consider desirable, and, owing to the action of

Fig. 19.—Dr. Little's Shoe for Varus of the left foot.



a, strap to be attached to the buckle *b*, intended to moderate the action of the lever-spring *c*; *d*, two straps which start from within the heel-piece on the outer side of the foot near the sole-piece, and are intended to be secured to buckles on the opposite side of the instrument, for the purpose of holding the posterior part of the foot firmly against the inside of the shoe, whilst the strap *e*, and short spring to which it is attached, draw the front of the foot outwardly. The convalescent may take exercise in this apparatus.

the spring lever, continually disposing the patient to tread on the inner margin of the sole.

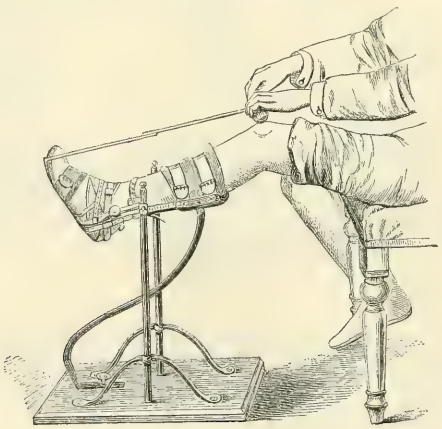
Cases of the first grade of infantile deformity are usually rectified in two or three weeks, those of the second grade in about four weeks, and those of the highest grade, the operation and the mechanical treatment having been divided into two or three stages, within two or three months. The treatment of adolescents and *curable* adults varies from two to twelve months.

Relapse not rarely occurs after the most complete flexion and abduction has been obtained. It takes place insensibly, at all ages, especially when growth is most rapid, and is due to too early discontinuance of instruments, and to neglect of manipulations and of passive and active exercises whilst the foot remained in a good position and the patient was enabled to tread in a natural manner. The worst so-called relapses result from previous incompleteness of operation or of restoration. No case should be considered finally cured until the mental development of the

patient is sufficiently advanced for him to take an interest in his cure, and to be able voluntarily to hold the part in a perfect position, and perform the natural movements of it. In relapsed cases repetition of tenotomy is not commonly required. Often the *tendons* will be found of ample length; sometimes the diminutive belly of the gastrocnemius, for example, wasted through want of the stimulus of adequate alternate flexion and extension—*i.e.* proper exercise—being shortened and drawn up towards the popliteal region. A common cause of relapse is doubtless the previous insufficient curative elongation of the fasciæ, ligaments, and muscles situated on the contracted side of the member, and is favoured by the corresponding relaxation and weakness of structures on the opposite side. Continuous gentle re-application of the extending apparatus, aided, as soon as flexion to the right angle is reached, by exercise with a wedge of cork beneath the front of the sole, suffices to restore these cases usually within a few weeks—*i.e.* within the period the patient would have been required to lay up if tenotomy had been repeated. It is satisfactory to be able, not only to spare the patient and friends the concern incidental to any operation, but to be able to avert, by mechanical means only, without loss of time, the discredit which attaches to the repetition of the operation.

Much benefit is derivable from a foot-exercising gymnastic apparatus which a patient above the age of four years can be directed to use for some minutes, or older patients even for some quarter of an hour, two or three times in a day. The accompanying drawing sufficiently explains the necessary proceeding calculated to obtain greater mobility at ankle-joint, and increased alternating elongation and shortening of the flexor and extensor muscles of the foot. The author originally employed Stromeyer's foot-board for this purpose. In the treatment of relapsed adolescents,

Fig. 20.—Exercising apparatus to aid in *completing* the bending of a resisting ankle-joint, suggested by seeing the application of the same principle in the first Great International Exhibition in 1851, forwarded by Dr. Behrend of Berlin.



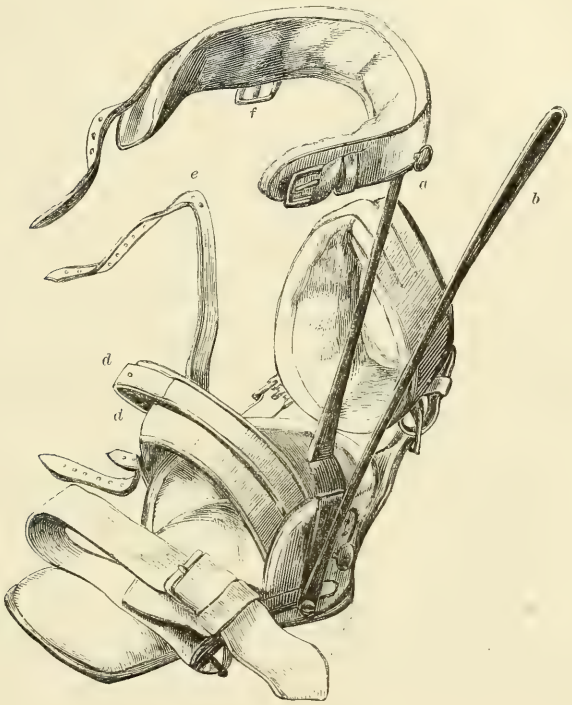
an apparatus that will bear the risks of walking exercise, and at the same time favour mobility of the ankle-joint in the required direction, is afforded by fig. 21.

After the operation for club-foot, even in infants, continuous application of splints or other apparatus is required for four or five weeks; in older children, for two or three months. The less severe the case, the more often the apparatus may be removed for cleanliness, and to examine lest undue pressure is employed. It is the boast of successful treatment of club-foot to be able to accomplish this result without a single excoriation. The surgeon should watch that, in his efforts to depress the heel and abduct the foot, the part be not too long maintained in one position, to the extent that the power of lowering the toes and of inverting the foot is lost; or, in other words, a valgus be engendered in exchange for the varus. This secondary valgus has been attributed to the non-union of the severed posterior tibial tendon.

It is really due to too long-continued retention of the foot in an abducting apparatus. We have witnessed it in children born with varus, who had been treated without operation. Its production is favoured by the same constitutional debility which produces spurious valgus, or flat-foot, in rapidly-growing children, who have previously had perfect feet.

Instrumental treatment is further required during at least a portion of each twenty-four hours, until the individual is enabled to plant the entire sole evenly and properly upon the ground, to thoroughly flex and extend the part at will, and

Fig. 21.—Dr. Little's double-hinged upright Shoe for severe rigid Varus of left foot.



a, stiff upright, hinged in two places, which when applied to the leg adapts itself to any degree of deformity; *b*, a spring curved outwardly, which when brought into contact with *a* can be then secured by means of a swivel-stud; *d d*, two straps for purposes similar to straps *d*, in figure 19; *e*, moderating strap, to be secured to *f*, as required. If the act of bringing the spring *b* into contact with *a* should occasion too much strain, *b* can be fastened at any required distance from *a*, by means of a tape. In the application of a varus shoe, success depends much upon the nicety with which the sole is applied to the sole-plate of the apparatus, and upon careful adjustment of the power employed. The foot-part of the shoe should be properly applied before the upright lever is secured. The moderating-strap is the last to be fastened. The sole should be covered with a thick layer of gutta-percha or india-rubber.

habitually, when walking properly, to evert the toes. In numerous cases a child requires no apparatus after the age of five or six months; but the majority need some instrumental aid such as leg-irons to evert the entire extremity until the intelligence is sufficiently awakened—say, until the age of three years. The maintenance of the 'cure' depends, as in all diseases, greatly, if not mainly, upon the individual or his natural guardian. We have had cases under observation off and on from infancy to puberty, owing to successive relapses, which have more commonly occurred abroad or in the colonies. We have witnessed examples of adults returning to be re-operated on, who have been successfully referred to their own efforts, with a few instructions as to mechanical attention.

After tenotomy no replacement of the part should be attempted until the puncture has cicatrised. Much has been written respecting the propriety of immediate replacement. It is unnecessary in slight cases, and impossible in severe ones.

In slight cases, nothing is gained by it; for, if the position may be immediately rectified, the part cannot be immediately used. The limb should therefore be gradually replaced while the tendon is consolidating itself.

We have often seen in consultation slight cases in which the Achilles tendon had been, perhaps unnecessarily, divided, or had been divided before the inversion had been sufficiently overcome; the foot had been immediately placed in a fully bent position, and converted into a, probably permanent, talipes calcaneus. Many surgeons have stated that they have never seen any harm from immediate complete fixation of the foot in a fully flexed position. The experience of such surgeons justifying this statement is widely different to that of surgeons who have made this matter a special subject of observation.

The influence, in interfering with union, of too considerable and too early separation of the ends of a severed tendon, and especially of frequent motion, as in walking, is incontestable. Experiments upon animals have proved that considerable lengths of tendon may be excised, and union nevertheless ensue; but the knowledge possessed of the great extent of the powers of the economy is an insufficient reason for neglect of those rules of caution which experience dictates. The immediate separation of a severed tendon to too great an extent should be avoided. Half or three-quarters of an inch may be safely borne, although as a rule gradual separation is preferable. The condition of a severed tendon approaches that of a fractured bone; too great separation of the severed ends, depression of temperature sufficient to suspend active arterial circulation, too early movement of the parts, and inherent vice of constitution, may cause tendon, like bone, to remain imperfectly united.

Stromeyer has suggested, that previously to operation the patient should be accustomed to wear the replacing instrument. This plan is desirable when the practitioner is unfamiliar with the treatment of deformities; for he thereby becomes versed in the action and mode of application of the apparatus, and is rendered certain beforehand of the appropriateness of the contrivance.

With reference to the choice of the apparatus, Stromeyer has rightly remarked, that every practitioner will select that of which he best understands the action and mode of application. This sagacious observation explains also one cause of the zeal with which each writer advocates his particular appliance.

It cannot be too strongly insisted upon, that in a large number of deformities, whether treated with or without operation, expensive instruments are unnecessary. More depends upon the tact, patience, and perseverance of the practitioner than upon the particular apparatus employed. Common roller bandages, with or without starch and plaster of Paris, tin, wood, or gutta-percha splints, aided by manipulations, may, in ingenious hands, supply the place of the most elaborate contrivances.

It may sometimes happen that no instrument is available, and the after-treatment may require to be conducted entirely by manipulations. Thus an adolescent case of double congenital varus was admitted into the London Hospital, under the care of Mr. Critchett, presenting large ulcers with necrosis on the dorsum of each foot, induced by pressure during the mechanical treatment after tenotomy. As the unhealthy character of the ulcers depended upon want of air and exercise, and the application of suitable instruments was impossible, we recommended not to wait for cicatrisation of the ulcers, but to repeat tenotomy, and effect forcible manipulations of the members. Chloroform was upon one occasion employed. By these means the feet were gradually straightened, cicatrisation of the ulcers was thereby favoured, and within three months the lad quitted the hospital entirely restored.

After congenital varus, as after acquired deformities, retentive apparatus may be required; these for the most part consist of jointed irons to support the weak articulations, and springs to assist the action of the debilitated muscles. These should be made of steel, or of caoutchouc, after the manner in which Gray, the manufacturer of artificial legs, employed it as a substitute for living muscles.[1]

The completeness of recovery in the great majority of the cases of congenital varus constitutes one of the triumphs of surgical art.

[1] This use of india-rubber was brought to the notice of the profession by the author in *Treatise on Deformities*, 1853, p. 36.

During childhood congenital varus may be entirely cured, without other traces of deformity than smallness of the member, greater squareness of the front of the foot, and sometimes less complete mobility of the ankle-joint, the patient recovering entire volition. When the case is unattended to before adult age, the internal margin of the foot may never be completely applied to the ground, owing to the impossibility, in some cases, of perfectly unfolding the os cuboides from its inferior and rotated position in the tarsus; in other instances, owing probably to the round head and neck of the astragalus having become so much inverted in relation to the remainder of the bone, that part of the undue convexity of the tarsus outwards becomes irremediable. Every year reduces the number of adult cases of varus requiring treatment, so that the consideration of any means of meeting the attendant difficulties may appear superfluous. The author has often found an efficient agent in a firm pad placed in the sole beneath the os cuboides, pressure being at the same time made upon the upper surface of the other tarsal bones.

During the last ten years, several surgeons, who it is obvious have had no experience of the success which attends the treatment of congenital varus upon the principles laid down in this work, have resorted to larger surgical operations in children than have been here recommended. These operations have been dictated by the desire to spare the expense of mechanical apparatus, and more effectually to guard against the necessity of attention to prevent relapse, as well as to save time and trouble to the patient and the surgeon. They have even in children and adolescents removed a considerable wedge-shaped portion of the tarsal bones, literally severing or almost severing the bony frame of the foot, and removing by a sort of surgical joinery as large a wedge of it as suffices to give the foot a valgoid rather than a varus distortion, and to destroy the natural arch. A third operation consists in freely opening the ankle-joint, removing therefrom the least offending, because the least displaced, of the bones—the astragalus; so that by loosening the connection of the foot with the leg the surgeon can give the form he desires. Another surgeon, in order, it is presumed, to facilitate removal of the astragalus and favour subsequent eversion of the foot, also removes that part of the fibula which constitutes the external malleolus.[1] The public journals have recorded deaths from these operations. The author has examined two of the recovered cases; in them the arch was destroyed, the foot much shortened, a valgoid state having succeeded to varus. The effect of the last of the above operations is to occasion partial anchylosis or loss of movement of the ankle, and as most newly-made joints commonly after a time become anchylosed, this result may be expected to follow this operation. When it is remembered that these operations of tarsal osteotomy have been performed in young children, who might have been cured almost as quickly in the ordinary way without mutilation of limb or danger to health or life, it is unnecessary to say more in deprecation of its employment. To lessen or remove distortion should not be so much the aim of the surgeon as the restoration of the part to a state of integrity, and this can be effected by any painstaking surgeon versed in orthopædy. To restore parts to integrity of form and function by mostly painless division of tendons and gentle gradual replacement, ought not to be considered below the dignity of the surgeon, aided by the right-minded parent and trustworthy nurse.

Congenital Talipes equinus, Talipes equino-varus, Talipes valgus, Talipes equino-valgus, Talipes calcaneo-valgus, and Calcaneo-varus.

By talipes equinus is understood morbid contraction of the muscles of the calf, and consequent depression of the toes, the adductors being unaffected. This is a very rare *congenital* affection. We have met with two cases in the same family—the first born, and the last child, the eleventh. When it has not been treated in infancy, locomotion is effected on the inferior extremities of the metatarsal bones and

[1] Dr. Rupprecht, *Jahresbericht des Gesellschaft für Natur- und Heilkunde*, Dresden, 1881 p. 39.

phalanges. In severe cases the internal margin of the foot is slightly inclined inwardly, and the metatarsus is projected forwards. There is not, as in varus, any disposition to tread exclusively on the outside of the fifth metatarsal bone or on the dorsum.

The existence of congenital talipes equinus has been emphatically denied. It is a question of fact and capability of discrimination. It may be suspected that the rare cases of congenital equinus which may have fallen under the observation of those who have denied its existence have been erroneously classed as varus. In congenital contraction of the muscles of the calf, owing to morbid elevation of the heel, the narrow portion only of the trochlea of the astragalus is retained within the malleoli, and the front of the foot falls or is drawn readily either inwardly or outwardly; the more ready or usual direction being inward; just as we see in some sound children there is a preponderance of the adductors (tibiales) over the peronei, and the feet are consequently observed to be turned in more often than out. Consequently the surgeon who makes no allowance for the ordinary tendency of the feet to incline, and who considers a case to be varus when he sees the foot with never so slight an inward inclination, does not believe in the existence of congenital talipes equinus.

Fig. 22.—Congenital Talipes Equinus.

The few cases of unoperated congenital adult equinus which we have seen have remained talipes equinus throughout. The patients have continued to walk on the metatarsal extremity of the great toe, as well as on the little toe.[1] The great toe has never been raised from the ground, as it is in congenital varus. No original or secondary affection of the adductors had drawn the foot in, so as to resemble congenital varus or even non-congenital equino-varus. The patient, we repeat, still walked on the ends of all the metatarsal bones, and especially on those of the great toe and the little toe.

If congenital equinus be rejected upon the ground that must be taken by those who deny its existence, then it may as justly be asserted that neither does non-congenital talipes equinus exist; for there is no non-congenital talipes equinus in which a trace of inversion or of eversion cannot be discovered, which when very marked is termed either talipes equino-varus or talipes equino-valgus.

The discussion as to the existence or non-existence of congenital talipes equinus continues for the same reason that discussion is endless in every department of natural history, as to whether a given object belongs to one species or forms another species;

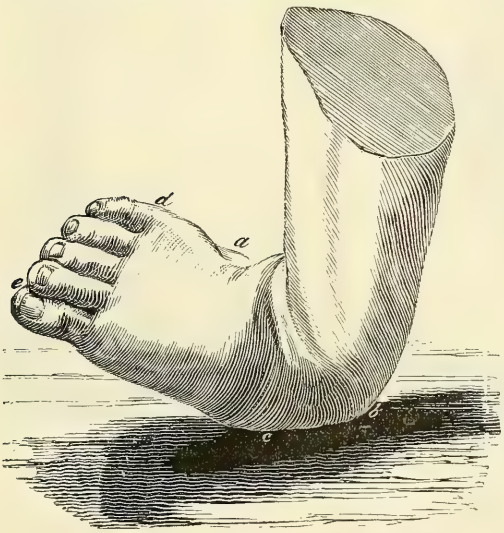
[1] We have recently examined an adolescent with well-marked hereditary congenital equinus. It was further remarkable by constituting the fifth example of the deformity in living members of the family, viz., the father, two paternal uncles, and one aunt.

one observer recognising a radical difference, which another observer either overlooks or explains away as belonging to another species.

Talipes valgus, equino-valgus, and calcaneo-valgus, whether congenital or acquired, are the terms applied to those distortions which contrast most with talipes varus, or ordinary club-foot. The front of the foot is more or less turned out in each of these varieties, instead of being inverted as in varus. In valgus the peronei are the muscles mainly contracted; in equino-valgus the tendo Achillis is also tense, and the heel elevated, the toes at the same time pointing outwardly. In congenital calcaneo-valgus the heel is depressed through the contraction of the anterior tibial, and the toes pointed outwardly from tension of the peronei. In non-congenital calcaneo-valgus the depressed heel is due primarily to evident paralytic wasting of the calf-muscles.

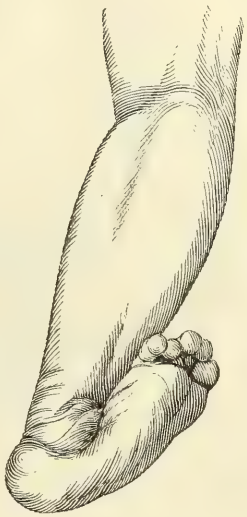
The foot deformities named respectively equino-varus and equino-valgus are both non-congenital, and offer other points of analogy, the chief of which is their dependence upon either spasmodic or paralytic contraction, as the case may be.

Fig. 23.—Front view of a congenital Talipes Valgus of the right foot of a boy aged four years.



d a, the outer edge of the foot raised from the ground; *e*, the great toe raised from the ground, although the internal edge of the foot is directed towards it; *b*, the internal malleolus; and *c*, the internal extremity of the navicular bone, being the parts upon which the patient walked.

Fig. 24.—Extreme Congenital Calcaneo-Valgus.



The reader, on comparing fig. 25 with fig. 16, will perceive the similarity of form between equino-varus (a non-congenital affection) and congenital varus, and might reasonably conclude that little reason exists, as far as an external form is concerned, for making any distinction between them. An essential difference is, that congenital varus is fully formed at the time of the child's appearance in the world, whereas equino-varus, when it proceeds from paralysis, is gradually produced, slowly attaining the maximum of distortion. In spasmodic equino-varus also the distortion resulting from either obvious or obscure disorder of the nervous system is rarely complete *ab initio*; on the contrary, it is for the most part slowly developed. The analogy of equino-valgus (fig. 26) in some respects with equino-varus is apparent. In both there exists contraction of the tendo Achillis; both are produced after birth from either spasms or paralysis. In equino-valgus the front of the foot is everted, and not inverted as in varus.

The deformed, enlarged, and protuberant heel of talipes-calcaneo-valgus is the consequence of several years' locomotion on the posterior extremity of the os calcis. This bone has in effect, in the fully developed deformity, a nearly vertical instead of the nearly horizontal position which obtains in the well-shaped foot (see fig. 28).

The rules already laid down for judging of the necessity for tenotomy in varus and the number of contracted tendons to be divided, apply to each of the distortions now under consideration. The principles which should direct the mechanical treat-

Fig. 25.—Non-congenital T. Equino-Varus. The arrows indicate the direction of the convexity of the tarsus and metatarsus, forwards and outwards; the perpendicular line through the axis of the limb shows the extent of the inward deviation of the metatarsus, by which the base of the little toe, being brought completely beneath the axis, has to support the entire weight of the body in walking; and is, in consequence of its attrition against the ground, a considerable cause of suffering.

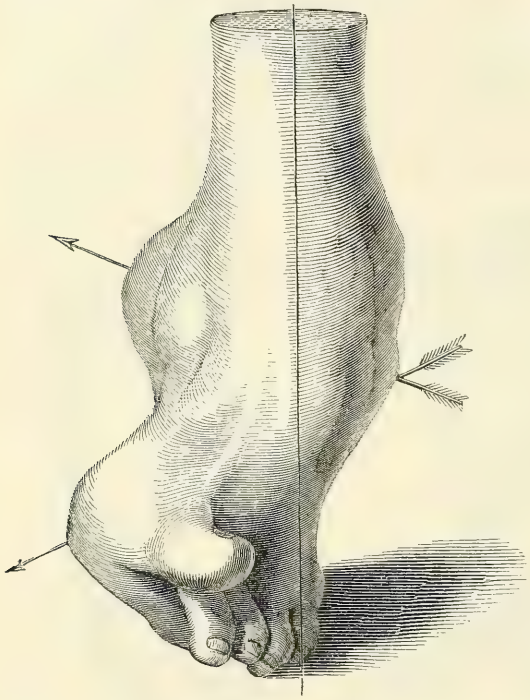


Fig. 26.—Talipes Equino-Valgus, from loss of power in anterior tibialis, and consequent contraction of calf muscles, and of peronei.

Fig. 27.—Early stage of Non-congenital Calcaneo-Valgus.

Fig. 28.—Fully developed Non-congenital Calcaneo-Valgus, from paralysis of gastrocnemii and consequent contraction of muscles of the sole, of anterior tibial, and peronei muscles. In some instances the anterior tibial shares the fate of the gastrocnemii.

ment are equally applicable. The experience and ingenuity of the surgeon are required to adapt the apparatus to the peculiarities of each case.

A variety of congenital varus occasionally presents itself, in which the inner margin of the foot is slightly raised, the sole contracted, and the dorsum prominent

towards the outer side of the foot, but without elevation of the heel. In these cases the muscles of the ankle are unaffected. We have designated this affection calcaneo-varus; it is also called plantar-varus. The treatment consists in making pressure by means of a pad upon the prominent dorsum, and in suitable manipulations. A beneficial result is soon observed; but the affection is prone to return. Division of the plantar fascia and of the long flexors of the great toe rarely exercises as much permanent benefit as is expected, because the quantity of plantar textures necessarily left unsevered suffice after cessation of the treatment to reproduce contraction. Moreover, calcaneo-varus does not seriously impair locomotion.

Some irregular *congenital* foot-distortions are met with. In a few of these we find distinct paralytic loss of muscular power: in one case well-marked paralytic varus, with much atrophy of the soft and hard parts; in another, paralytic contraction of the hips, knees, and feet, with implication of the upper extremity. The only treatment applicable is to relieve contraction by manipulation, friction, and in unyielding cases by tenotomy, thus offering a chance to the muscles which remain partially under the will, to support the individual in attempts to effect imperfect locomotion. We have watched these cases from birth to adolescence, and a few to advanced age; in many the paralysis has remained undiminished. In other instances of contracted limbs from infantile paralysis, the primary disorder is augmented about the time of the grand climacteric.

Distortions originating at the moment of Birth.

We have seen that in the earliest times of the study of congenital distortions, they were successively attributed to the anger of the Deity, lusus naturæ, malposition in, and pressure of, the uterus. In the present day, an enlarged observation of non-congenital as well as congenital distortions leads irrefragably to the conclusion, that the numerous causes which are found to operate in the production of distortion after uterine existence, exercise analogous if not identical effects, whilst the fœtus remains within the uterus. These causes are, hereditary and maternal influences, disturbance of the nutritive, respiratory, circulatory, and nervous systems of the fœtus and infant, accidents, entanglement by the funis and abnormal bands, intra-uterine fractures, malposition and pressure, fixed repose in one position, and inflammation. In order to illustrate the obnoxiousness to distortion existing at every epoch, we shall here describe a group of distortions, many of which unquestionably take their origin at the period intervening between uterine and independent life, that is, *during* birth. (See classification, p. 227). We believe we can particularise the moment, as that interval which unfortunately in cases of abnormal labour connects the cessation of placental with the beginning of pulmonary respiration. When we reflect upon the important phenomena in the economy at the moment when it should adapt itself to the immense changes involved in the abrupt transfer of the oxygenating process of the blood from the placental to the pulmonary cell surfaces, we should anticipate that any retardation, interruption, or arrest of this transfer of the most important function should be attended with the greatest evil to the system at large, and especially to the most susceptible, the nervous system.

We know that a state of suspended respiration and animation is the common consequence of many of the accidents attendant upon birth; and we might infer, from the evils often witnessed after recovery from the asphyxia of drowning or of choke-damp, what might be the consequences of the apnœa and asphyxia of new-born children. Some of these entirely escaped notice by the profession, until published by the author in the *Lancet* in 1843–4. The lungs suffer in the form of atelectasis; the heart probably in delayed or deficient closure of the foramen ovale, and possibly in straining of its walls; the nervous centres from effusions and apoplexy, followed by impeded developments, atrophy of individual parts, sometimes by impaired intellect and volition, convulsions, and spasmodic contractions.

It is scarcely necessary to add, that difficult and instrumental labours, and those in which the cranial bones and brain, and even the vertebræ and their contents,

have suffered mechanical injury, are more likely to be followed, if not by death, at least by general convulsions and other serious derangement of the nervous system, of which a prominent symptom are the 'internal' or subdued convulsions of the nursery.[1]

A common class of affections resulting from injury at birth, whether the injury be mechanical or vital, consists of a peculiar diminution of volition with tonic rigidity, in varying degrees of a part or of the whole of the muscles of the body, described as 'the spastic rigidity of new-born children.' Both lower extremities are more or less generally involved. Often one limb only is referred to by the parents; but careful examination usually shows a smaller degree of impairment in the limb supposed to be unaffected. In some of these contractions originating at the moment of birth, the cases are of distinct hemiplegic character, the paralysis having passed off during the first year of life, the more or less active spasmodic contraction with structural or adapted shortening remaining (retraction musculaire of Guérin). This state of peculiar spastic rigidity of young infants may even continue through the whole duration of life. We have known patients over forty years of age thus affected from birth.

Fig. 29.—Spastic Contraction of Flexors and Adductors of the Lower Extremities (with knock-knees), consequent on Asphyxia Neonatorum. Similar distortion may result from 'convulsions' during teething and other cerebro-spinal affections.

The amount of contraction in the hips, knees, and ankles is often considerable, and the leanness proportionate to the contraction. The flexors and adductors of the thighs, the flexors of the knees, and the posterior muscles of the legs preponderate. The thighs and knees cannot therefore be completely extended, or the heels be applied to the ground. In some cases the upper extremities are held down by the preponderating action of the pectorals, teres major and minor, and latissimus dorsi; the elbows are semi-flexed, the wrists partially flexed and pronated, and the fingers incapable of perfect voluntary direction. Participation of the muscles of the trunk is sometimes shown by the shortened, flattened aspect of the pectoral and abdominal surface, as compared with the more elongated, rounded form of the back. The prominence of the back partially disappears on recumbency; but the greater weakness of the muscles on the dorsal aspect of the trunk is obvious when the individual again attempts to sit upright. The inability and indisposition to exert the abdominal and other muscles concerned in the expulsive processes may, perhaps, sufficiently explain the tendency both to rare micturition and defecation which sometimes exists. The muscles of speech are often involved, the affection varying in degree from inability correctly to utter one or more letters of the alphabet, up to the entire loss of the articulating power. During the earliest months of life, deglutition is often impaired. The intellectual functions sometimes suffer, from the slightest impairment, which the fond parent unwillingly acknowledges or fails to perceive, up to entire imbecility or idiocy. The functions of organic life are unaffected, except perhaps that of development of caloric, although the depression of temperature may be more dependent on the want of proper exercise. The appetite is good; the frame generally, in average cases, is well nourished, although with less than the average adipose deposit. The child is often described as the healthiest of the family, escaping epidemics, or having these disorders less severely than the brothers and sisters. These subjects often lead a more precarious existence during the first weeks after birth; at first even vegetative life languishes, often because premature birth or difficult labour, by impairing the maternal supply of nutriment, renders more difficult the infant's recovery from the shock the system has received. However, in

[1] See Little, 'On the Influence of Abnormal Parturition on the Mental and Bodily Condition of the Infant,' *Transactions of the Obstetrical Society*, 1862.

the majority of instances, after restoration of the vegetative functions, a gradual amelioration of all the functions of animal life is perceptible.

Although at first convulsions are the rule, the *spastic* contractions are not present, or are not observed, until some weeks after birth. The child's limbs are simply weaker; the convulsions and the question of viability alone occupy the thoughts of the attendants. Before the age of three or four months, though sometimes in slight cases not until the ordinary time for locomotion has arrived, the nurse perceives that she is unable properly to separate the thighs or knees for purposes of cleanliness; that the child never thoroughly straightens the knees; that he does not attempt to stand, or is incapable of standing except on the toes, or that the feet are disposed to cross each other. Even children slightly affected rarely 'go alone' before the age of three or four years; many are unable to raise themselves from the ground at that age, and others do not walk even indifferently at puberty without the support of some neighbouring articles of furniture. Locomotive ability seems to advance in proportion as the intellectual powers are developed. The external form of the cranium occasionally exhibits departure from the normal type—such as general smallness of the skull, depression of the frontal or occipital region only; sometimes of one lateral half of the skull, sometimes of one-half of the occiput only.[1] In slight cases the head has been well developed. The *ensemble* of phenomena points to injury more or less extensive of the cranial contents, and especially of the medulla oblongata and spinalis.

In all cases, even with great inertia as to the exercise of volition, common sensibility appears little if at all deficient. On the contrary, a morbid sensibility of the organ of hearing and of the cutaneous envelope appears to exist, evinced by 'startling' at the slightest noises, and extreme sensibility to touch. This morbid sensibility may be due to a condition of spinal cord analogous to that present in narcotized frogs, in individuals under the influence of strychnine, or those affected by tetanus. It may, however, be apparent only, dependent upon the individual, when subjected to common noises, being less competent quietly and promptly to reason upon them, and by thus reassuring the easily disturbed nervous mind, to escape from the exciting influence. In many cases the intellect has been intact. A peculiarity of these children—an uncommon fear of falling—is often observed when they are seated on a couch, less when they are on the floor, and not observed when they are seated in an arm-chair; a circumstance clearly due to conscious inability to balance and recover the position of the body.

Spastic Contractions from Cerebro-spinal Disease in Infancy and Childhood.

We have just described a state of more or less general spastic contraction, which results from disturbance of the cerebro-spinal centres at the moment of birth, either from direct injury to the cranium or neck whilst passing through the maternal parts, or, more probably, from asphyxia consequent upon interruption to the substitution of pulmonary for placental respiration. Sometimes, without premature or difficult labour having preceded, convulsions occur very soon after birth, during the first hours, days, or weeks of independent existence. The author has met with a case of slight disturbance of parturition followed in the child a few days after birth by convulsions, which continued with little intermission night and day for a fortnight. The child recovered and has become robust in mind and body. Convulsions, as is well known, occur more frequently after dentition has made some progress, whilst the infant is undergoing another transition, that of passing through the crisis from nourishment by the mother's breast to feeding, when unfavourable consequences of deprivation of breast-milk are apt to show themselves. The infant may be of previously unexceptionable history, except that the parents may be the subjects of disorders of the nervous system, of nervous temperament, have overtasked brains, have

[1] Morbid anatomy reveals in these cases a corresponding deficiency in size of the affected parts of the cranial contents.

been phthisical, or are intemperate. These convulsions now and then leave the sufferer impaired in mental power, and affected with spastic rigidity, undistinguishable from that which succeeds apnœa and asphyxia neonatorum (see fig. 29). It is scarcely necessary to add to the previous remarks on spasmodic and paralytic contractions that convulsions and other cerebro-spinal morbid states of childhood may be followed by spastic contraction, or paralysis of single muscles or of sets of associated muscles.

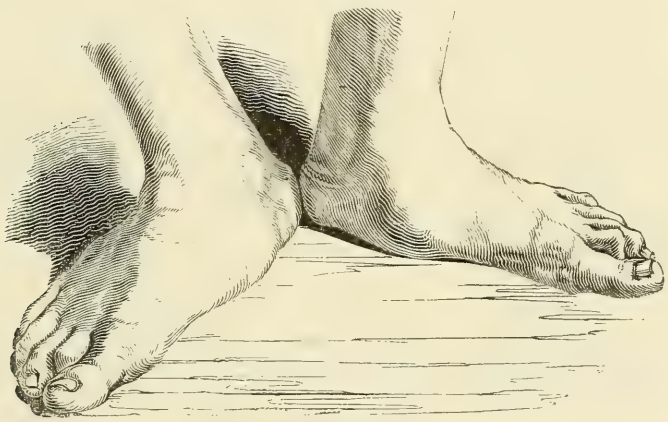
Treatment.—The indications for either the operative or mechanical treatment of these different forms of spastic and paralytic contractions, and the mode of conducting the treatment, are the same as those laid down in speaking of congenital club-foot (p. 235), modified by the nature of the cause of contraction. In contradistinction to congenital contractions we may remark that in contractions occurring during teething, the occurrence of structural shortening may generally be prevented by timely-applied manipulations, frictions, mechanical support to paralysed parts, or assistance to the antagonists in the case of spastic affections. It should be remembered as a reason for avoiding unnecessary tenotomy, that the contracted muscle is often the healthier one, and that in the case of a spasmodically affected muscle, tenotomy does not 'cure' the spasm. It is often only temporarily beneficial, and sometimes transfers the preponderance to another set of muscles, merely substituting one evil for another. In severe general spastic contraction, the surgeon has carefully to balance the good and evil of plans of treatment one against the other.

Flat-foot, or spurious Valgus, atonic and rachitic.

This common deformity presents externally many of the characters of congenital valgus, and of the acquired valgus which results from paralysis of the anterior tibial muscle. But the resemblance is only superficial. The person treads unduly on the inner margin of the foot, the toes are turned outwardly, and the arch of the foot is diminished, or, in severe cases, may be obliterated; hence the term flat-foot. True valgus springs from congenital contraction of the peronei muscles; spastic non-congenital valgus from spasm of the peronei; paralytic valgus from partial or total paralysis of the anterior tibial; sometimes combined with paralysis of the posterior tibial, causing contraction of the peronei owing to the want of antagonists; but spurious valgus or flat-foot is due to general want of tone in the fibrous structures of the body—atonic valgus—displayed in the yielding of one of the parts of the frame most exposed to strain, the plantar muscles and ligaments; hence sinking of the arch, eversion of the toes, and secondary contraction of the peronei. In many atonic cases in early life the ankle-joint and foot present a normal appearance when the individual is seated and bears no weight upon them. The only abnormal conditions then present being that of increased laxity and mobility. Other cases have a distinctly rachitic origin, the *bones* being softened and yielding in consequence of the superincumbent weight. After a time the displacement of the tarsal bones, connected with the sinking of the arch, leads to painful or difficult locomotion and limitation of the movement of the ankle-joint. Finally, the tarsus may become convex inferiorly, concave superiorly, the anterior part of the foot being then drawn up by the conjoint action of the anterior tibial and the extensors of the toes, and the heel held tensely upwards by the muscles of the calf. Even in moderate cases contraction of the peronei is distinctly felt; in severe cases shortening of the remaining muscles above enumerated is also evident. In the worst cases scarcely any mobility of the ankle-joint remains. A slight degree of atonic valgus is common in girls, especially amongst those of fine organisation in the upper and middle classes of society; less frequent in boys; and is frequently curable amongst them by considerably reducing the amount of standing and walking exercise, by substituting horse exercise where practicable, by avoiding too fast walking in the company of adults, by early hours, by avoiding competitive over-study, by generous living, fresh air, tonics, attention to the state of the primæ viæ, embrocations, and manipulations directed to the promotion of inversion of the foot and prevention of the threatened

contraction. In greater relaxation of the parts about the inner ankle, actual confinement to a couch, and carriage exercise for a month or five weeks, or that time spent on the sands or beach at the sea-side, or riding astride a horse without stirrups, will lay the foundation for cure. Boys of the suitable class may be brought up as tailors who work cross-legged. Girls seated on the floor or sofa cross-legged, may with advantage do a part of their needlework or schoolwork in this position, which is eminently conducive to cure eversion of the feet and restoration of the arch. Laced boots, supported at the sides with stiff leather or thin steel busks, are of great assistance in walking. An elastic horse-hair, india-rubber, or felt pad beneath the inner margin of the foot tends to support the arch. Iron and cork, often employed for this purpose, are harsh and inefficient. We must utterly condemn a practice often resorted to in contempt of the pathology of the affection—that of severing the peronei and tendo Achillis in all such cases. The recovery of patients from moderate flat-foot when this operation has been performed, is due mainly to the absolute repose of the limb with which the operation is followed, and to the mechanical measures concurrently employed. But in a few rare cases in private practice, and in those of boys who have stood prematurely behind a counter twelve or fourteen hours daily, and amongst the labouring classes in public hospitals who have suffered from pre-

Fig. 30.—Severe Flat-foot or Spurious Valgus.



maturely carrying heavy weights, the deformity has existed so great a length of time that the contracted muscles have become shortened and rigid, rendering tenotomy, with its promptness and certainty of action, a necessary adjunct to the mechanical treatment.

Flat-foot often exists for several years without attaining even an intermediate grade of severity, when all at once a particularly long walk, a leap, or initiation into a standing occupation, becomes the starting-point of a considerable and rapid aggravation. Sometimes evidence of chronic inflammation of the calcaneo-scaphoid ligament, or other plantar structures, or a painfully stretched condition of the plantar nerve, exists. This last symptom is recognised by the exquisite, unbearable, electric-like, painful, tearing sensation described by the patient when he takes a long stride, or stands on the affected leg alone. Sometimes a rheumatic valgoid foot may be recognised as a consequence of protracted rheumatic disturbance of the ankle and plantar structures, analogous to the rheumatic valgoid or in-knee distortion. We should not be induced to operate on flat-foot even on account of its long duration, or of palpable shortening of the tendons before enumerated, since even rigid contraction of muscles, healthy as to their innervation, will yield in a few weeks to judicious frictions, manipulations, disuse of the part (required in this deformity owing to its special exposure to aggravation by walking), and mechanical treatment. As an argument in favour of severing the Achilles and other tendons in slight cases we have heard the question put by a surgeon 'What harm does the section do?'

Now, although the tendo Achillis is very tolerant of the too ready operator's scalpel, it cannot be pretended that an unnecessary operation is a benefit. As, in extremely severe cases, the act of walking, after replacement of the tarsal bones, tends to bear down again the tarsal arch, the aid of mechanical appliances is subsequently needed for several months, or even sometimes for two or three years. Relief is much more readily obtainable in the child than in the adult. The apparatus available in these cases is the same as that used for varus, but with the action of the springs, screws, or lever reversed.

Subcutaneous division of the peroneus longus and brevis is effected in a manner similar to the operation of severing the tendo Achillis. The patient should lie over on the opposite side, an assistant holding the foot inwardly, so as to maintain extra tension of the parts. The tenotome should be introduced in front of the tendons, the section proceeding from within outwards.

Contractions of the Upper Extremity from Spasm and Paralysis.

The principles which should direct the application of tenotomy to spasmodic and paralytic contractions of the upper extremity are those which are applicable to other parts of the body, except in so far as the functions of the individual muscles of the upper extremity, especially those of the wrist and fingers, are more delicate, varied, and complex than, for example, are those of the corresponding parts of the lower extremity. We should be prepared to expect that a surgical proceeding which aims at intercalating a piece of new tendon, with the object of reducing the range of action, and therefore the power of a rebellious spastic muscle, or for the purpose of thereby weakening a healthy muscle so as to favour a partially paralysed antagonist to recover its activity, would be less successful than in the lower extremity, the actions and movements in which are comparatively simple. The acquirement of the power of progression, even if it be incomplete, amply compensates for the sacrifices the patient makes; in bad cases he is satisfied with the possession of a limited flexion and extension of the hip, knee, and ankle, and can be aided by mechanical appliances. But in the case of the wrist and fingers the individual derives little benefit from these simple movements, and he cannot be materially assisted by any complicated mechanism hitherto invented. We have divided the biceps at the bend of the elbow, the rigid well-defined pronator radii teres at its muscular portion, the tendons of the flexor carpi and radialis and ulnaris where most prominent close to the wrist, and have found the resulting benefit proportioned to the attention subsequently bestowed upon manipulations, passive exercises, and painstaking education of the enfeebled non-contracted extensors. Except in cases of many years' duration, in which the retracted muscles were reduced to inextensible fibrous bands, it has seemed that as much ultimate benefit was obtained by manipulations and exercises as by the employment of an operation, and at no greater expenditure of time. This has been the case in long-standing instances of contraction of the pectoral and scapular muscles, forming the border of the axillary region, due to long previous paralysis of the deltoid and probably of the supra-spinatus muscles. The prognosis must be based on the amount of improvement that may be expected in the affected portion of the nervous centres. As an encouragement to treatment, the surgeon should remember that cases occur in which the disorder of the nervous system and nerves has ceased, and that he has to deal only with consequences. This observation applies also to many congenital contractions.

In a case of this nature, osteotomy of bones of the upper extremity was effected with much advantage by Mr. L. S. Little, in 1868.[1]

Deformity from Palmar and Finger Contraction (Dupuytren's hand).

This not uncommon contraction in the upper extremity consists in a permanently flexed condition of one or more fingers, with apparently visible and palpable thicken-

[1] See the section on 'Osteotomy' in the essay on Surgical Diseases of Childhood, Vol. III.

ing and hypertrophy of the fascia investing the palmar surface of the first phalanx of the affected finger or fingers, and of the neighbouring portion of the palmar fascia. Sometimes the whole of the fingers and thumb are implicated, the palm itself is contracted, and the use of the member as a prehensile, and even as a tactile, organ almost destroyed. The ring and little fingers, the middle finger, index, and thumb, are usually affected in frequency and degree in the order in which we have placed them. The articulations are commonly unaffected, although occasionally that of the first phalanx, with the second phalanx, or this with the third, has exhibited slight arthritic enlargement. On endeavouring to straighten the fingers, the surgeon feels that a general resistance is offered by the tissues of the entire palmar surface of the hand and fingers, and especially by the palmar fascia itself. Any existing tension of the flexor tendons cannot be felt along the fingers, but in the palm, particularly in the upper part, above the edge of the most indurated part of the fascia, one or more prominent and tense tendons may be felt. This deformity is usually attributed to injury, often to a trifling wound, to irritation by the use of a whip in driving, of a walking-stick, or mechanical tool. These mechanical causes, or local irritants, if really operative, can be regarded only as occasional determining or exciting causes. We formerly believed the essential or primary cause to be a constitutional one, allied to the gouty or rheumatic diathesis. We may not venture, however, to assert that the constitutional cause is identical with that of gout or rheumatism, as the persons affected have appeared singularly free from other manifestations of those affections. The affection of the palmar fascia, unlike gout or rheumatism, is painless. An occasional patient affected with considerably contracted palmar fascia in both hands may present similar affection of the corresponding fascia of the soles; a sufficient proof that the complaint is essentially independent of the mechanical causes assigned for it,—unless, indeed, we assume that the act of walking by stretching the sole can act upon the plantar fascia and muscles after the manner of a mechanical irritant. The symmetrical character of the affection, the precise resemblance of one case with another, the frequent occurrence of the same deformity in father and son for several generations (four), as well as the above facts, confirm the opinion of its constitutional origin. We have never witnessed this complaint in the female. My patients affected with it have not been 'total abstainers.'

Fig. 31.—Contracture of Palm and Fingers. The habitual state of the hand was one of greater contraction; the drawing represents the appearance when the patient endeavoured by muscular action to extend the fingers.

Formerly we regarded it as a painless chronic induration of the fascia, leading to compulsory, gradually increasing disuse of the fingers and hand—that through this disuse the flexor muscles and tendons, being probably free from the original affection, asserted their preponderance over the equally idle extensors, and became gradually affected with secondary shortening.

The normal hand, placed as near as may be into the shape of one of these very contracted hands, so nearly resembles it, except as regards the absence of distinct contraction of tissues, that it is difficult not to believe that the skin has as much to do with the prominent ridges and furrows as the fascia, and that they are both thrown into folds by muscular action; in fact, that nerve muscle and tendon are the primary agents in the contraction, and not the fascia, as Dupuytren and subsequent writers (ourselves included) maintained. Often a prominent flexor tendon is predominant in the palm; we have seen the palmaris longus muscle and tendon in the forearm tensely contracted (see a case of this kind in Dupuytren [1]). When the patient is requested to

[1] *Sydenham Soc. Works*, vol. 1854. In the case in question, Dupuytren, it would appear, impressed with the idea of the dependence of the complaint upon disease of the

act upon the muscles of the forearm, the above tendons are rendered more tense and the distortion is increased. Doubtless the office of the palmaris longus is to render the palmar fascia tense. On full consideration of the arguments we could adduce for or against the nervo-muscular theory of the origin of this distortion, we arrive at the conclusion that this is the true cause and not *disease* of the fascia.[1]

Treatment.—Even in tolerably advanced cases, frictions, manipulations twice or oftener daily, the application of a screw-adjustment splint, or straight splints of wood, tin, or gutta-percha, will, if suitably and perseveringly used, reduce the contraction and deformity. But at the advanced age at which many patients present themselves for relief, the employment of mechanical apparatus encounters many difficulties. In rigid unyielding cases of long duration, subcutaneous section is remarkably efficacious. We cannot by its means alter the constitutional state, or instantly remove the induration of the fascia; but we are enabled to remove the contracted bands by subcutaneous section, and, so far as the contracted muscles are concerned, to take the case entirely out of the influence of the patient's will, and obtain a starting-point for further benefit by mechanical treatment. A puncture half a line in width suffices for the passage of a firm tenotome beneath the fascial band or the tendon in the palm. The division is effected from below upwards. No fumbling or unnecessary handling of the part after the operation, by which means air or blood might be disseminated amongst the palmar tissues, is permissible. The operation, like most subcutaneous operations, is bloodless. We have invariably seen the puncture heal within forty-eight hours. Considerable yielding or entire straightening of the contracted finger, the tendon of which has been severed, is at once perceived. We have rarely needed to sever more than two or three bands of fascia or tendons. Sometimes small contracted fascial or tendinous slips in the palm opposite the lower ends of the metacarpals, or passing between the fingers, when divided, afford instantaneous relief. It is necessary to mention that when a known flexor tendon has been severed in the palm, so that the finger could be at once entirely straightened, no immediate extension of the finger should be resorted to. The object should be to obtain no greater lengthening of a tendon than is needful. By supporting the wrist and fingers on a moderately bent flexible metal splint, the divided tendinous ends are brought near enough for agglutination. When the patient is seen to be able to move the finger, the part can be gradually extended without pain. If only fascial bands have been severed, extension should be made directly the puncture has cicatrised. It has been recommended in these cases to make, if required, as many as ten to fifteen subcutaneous sections of fascial bands, and under anæsthesia to forcibly straighten and bind the parts immediately upon straight splints. We have never needed to make these multiple sections nor to risk delay in healing by immediate stretching of the punctured cutis. The cutis is so firmly attached to the fascia that the one cannot be stretched without the other. When a single most retracted tense tendon in the upper part of the palm is severed, the whole complaint often yields at once. Manipulations and mechanical treatment complete the cure. We have frequently thus effected entire restoration of the hand and fingers. It is remarkable that the indurated structure quickly softens, and the hard ridges and corresponding furrows disappear, under this treatment. The rapid disappearance, within two or three weeks or a month, of the slight coexisting wrist contraction and very hollowed palm, as well as of the hard ridge and furrows which had existed several years in the palm, and at the root of the phalanges, has for a long time seemed to us an indication that they were due to a cause contracting those parts from a distance, such as one or more of the muscles of the forearm, including the palmaris longus, would be. It may be that the afflux of blood to the part excited and maintained by the frequent manipulations, frictions, and bandages, alters the nutrition of the part, and removes the previous morbid deposit, if any. It is also probable that caution as to diet and wine, whilst under the observation of the surgeon, assists this process of

palmar fascia, rejected the case because it pointed to dependence upon contraction of the palmaris longus.

[1] See Paper by the author in *Hunterian Soc. Trans.*, 1879.

recovery. The causes being constitutional, and the attention of the patient being liable to slacken after a lengthened recovered use of the member, the complaint occasionally returns, as do many other diseases.

Wry-Neck. Neck injury at birth.

Torticollis, or wry-neck, is not an uncommon distortion of the head and neck, originating, like club-foot, from a variety of influences; some acting through the muscles—congenital, spasmodic, paralytic; others acting through the ligaments and bones—rheumatic and strumous. Occasionally the point of departure of a case is strumous affection of the lymphatic glands, and sometimes loss of textures from sloughing after burns or a gunshot wound.

Congenital wry-neck.—This is the most common form of wry-neck. It is perceived a few months or more after birth, and, when suffered to proceed unchecked, gradually increases during childhood, adolescence, and adult life, until it attains the proportions of a formidable deformity. Many cases of wry-neck, reputed to be congenital, have appeared to originate from accidents at birth, in consequence of breech presentation, turning, &c. Infants have been brought to us a few weeks old with the neck observed to be unusually weak or loose from injury at birth. The muscles

Fig. 32.—Wry-neck from active Contraction of Sterno-cleido-Mastoideus.

appeared as if paralysed, for the connection of the head with the shoulders was looser than usual at the corresponding period. They recovered with a few general directions as to position and support by the hand when dressing or turning the child over. We will describe a young adult case of wry-neck, in which the right sterno-cleido-mastoideus is the head and front of the offending, for it is probable that other muscles are always either primarily or secondarily involved. The entire head leans to the right side and slightly forwards, the right side of the neck is somewhat hollowed, whilst the left side is unnaturally convex, and the patient not unfrequently complains of pain in this situation. The chin is drawn to one side and approaches the left shoulder; the right ear is approximated to the sternal extremity of the clavicle. The sterno-cleido-mastoideus of the affected side may, as in fig. 32, be well developed. Sometimes it has lost its symmetry, being reduced to a comparatively narrow, hard, tight cord, three inches in length, the muscle of the opposite side measuring five and a half inches. This prominent cord may be double below, representing the double origin of the muscle. In the adult a marked upward bend of the clavicle is often seen where the clavicular portion of the contracted muscle arises, induced by the constant abnormal traction to which the bone has been subjected, and the inferior portion of the muscle itself appears of cartilaginous hardness, and is lost in a large bony process on the protuberant clavicle. If we examine the neck and shoulders posteriorly, we observe that the cervical vertebræ have yielded to the dragging of the

contracted muscle; the column presenting a convexity on the left side, which is compensated for by a curvature in the opposite direction lower down. The right side of the head, neck, and right shoulder are considerably smaller than the parts on the opposite side; the right shoulder and scapula being unduly raised. A singular effect upon the face results from this difference in size, combined with the impediment to the function, which the abnormal position of the head involves. In the adult case from which we describe, so great is the difference in size between the two sides of the face, that on the right side the external canthus of the eye is distant from the external angle of the mouth three inches, whilst on the left the distance amounts to three and a half inches. The inclination of the head to the right causes the right eye to be habitually situated on a still lower plane than would be the case if atrophy of the affected side were alone operative. The atrophy and the slight bending forwards of the head interfere with the direction and use of the right eye, and causes a peculiar expression of archness or sense of difficulty and suffering. After successful treatment the disproportion of parts, even in aged individuals, is much lessened.

The principal muscles of the neck are sometimes involved, the trapezius and scaleni, as well as the sterno-mastoid. In this and other respects congenital wry-neck offers much analogy to congenital club-foot. The principal contraction affects in both cases muscles which pass over more than one articulation, the sterno-cleido-mastoid in one case, the gastrocnemius in the other; hence in the neck the mischief of morbid contraction may effect a higher degree of deformity than if the contracted muscle influenced one articulation only; in the leg the contracted gastrocnemius does not always limit its evil influence to the foot, but may contract and distort the knee. In both wry-neck and club-foot other muscles participate in the deformity; but the range of influence of these being less, or being counteracted by antagonistic powers, their contraction is not so apparent. It is an interesting question of physiological pathology whether there is anything special in the anatomy and function of the sterno-mastoid and gastrocnemius, that they should obtain the distinction of entering into so large a proportion of cases of congenital and acquired deformity. The gastrocnemius, by its great development, its greater nervous supply, and its relation to the upright stature and locomotion of man, is certainly entitled to a peculiar and elevated rank in myology; so, when we reflect upon the size of the sterno-cleido-mastoid, its relation to the large vessels of the head and neck, its deriving its nerve-power mainly from a special nerve (spinal accessory), and remember the influence of this muscle upon the act of respiration, we cannot deny it a pre-eminent function amongst its neighbouring muscles.

We have elsewhere shown [1] that not unfrequently wry-neck appears to result from straining or injury to the neck during difficult labour, from traction of the head by instruments. It is superfluous, after what we have said of the causes of congenital club-foot (p. 231), to refute in detail the theory which would attribute every case of wry-neck, like club-foot, to accidental uterine or pelvic pressure during birth. The greater number of cases of congenital wry-neck clearly originate from causes acting through the nervous system.

Treatment.—As with slight congenital club-foot, so slight cases of congenital wry-neck, if detected during the earliest months of life, are removable by frictions, manipulations, and subsequent education; but the majority of cases which we have treated, varying in age from four to forty-five years, have exhibited so much contraction and proportional secondary deformity, that we have rarely delayed operation when the patient had reached four or five years. It has always seemed advisable to gain at once, by means of this operation, a large measure of relief; thus affording an encouraging starting-point for the after-labours of the attendant in overcoming the shortening of the integuments, platysma, fascia, associated muscles, and ligaments on the hollow side of the neck, and, in this way, gradually acting upon the altered relation of the articular facets of the inclined vertebræ, or counteracting the tendency to such alteration.

[1] *Trans. Obstet. Soc.* 1862.

Division of the sterno-cleido-mastoideus is performed subcutaneously, upon the principles laid down by Stromeyer in division of the tendo Achillis, viz. effecting the division by the smallest possible wound in the integuments and the narrowest tract through the subcutaneous tissues, and avoiding any external bleeding or extravasation of blood into the areolar tissue, or admission of air into it. Neglect of these precautions, in this particular situation, would be calculated to excite suppuration and prevent immediate healing of the puncture, and delay untowardly the employment of the necessary after-treatment, until, perhaps, the severed tendon might be too closely reunited. The spot chosen for the operation may be that at which the tendon springs rigidly across the important subjacent organs, and where consequently most space is afforded for the introduction of an ordinary slightly convex-edged tenotome beneath the tendon without risk to those organs. In wry-neck this spot will be found from a half to one inch above the clavicle. It is also more easy to sever the muscle entirely by keeping at this distance from the bone. In some cases we have found the sterno portion only developed and rigidly contracted; a few weak fibres attached to the clavicle having, before the knife reached them, yielded to the tension maintained by the assistant. In cases in which the clavicular origin of the muscle is broad, it is safer to divide the sternal and clavicular portions each by a separate puncture, rather than pass the knife by one puncture made in front of the neck as far back as may be necessary to reach the whole of the clavicular portion. This precaution is justified by the anterior and posterior edges of the muscle not being on a plane surface; for, although the fasciæ of the lower part of the neck may usually bind down sufficiently the vessels and nerves, and so keep them out of danger, it is well to remember the liability of meeting with abnormal distribution. The complete division is accompanied by a very sensible crack, and the head at once assumes a much improved condition. We have measured immediately after operation, and have found the difference in length between the affected and sound muscle reduced more than one-half, but we have avoided before cicatrisation of the puncture fixing the head in the most improved position. The puncture should at once be covered with a compress of lint, and a common bandage be applied. We have found no harm result in the case of the sterno-cleido-mastoid in allowing the ends to separate as far as they were inclined to yield. In a few cases of very young children we have of late preferred dividing the muscle in the old situation, in the middle of the neck. In this situation we raise up the entire muscle between the left forefinger and thumb, pass the sharp pointed convex-edged tenotome through the integuments behind the muscle, keeping the flat surface of the instrument towards the muscle until the point touches the forefinger. On removing the thumb, whilst keeping the forefinger at its post, the convex edge of the tenotome is turned upwards, towards the muscle, which cuts itself completely through before, or whilst the surgeon gradually withdraws the knife; no to-and-fro movement of it being requisite. The surgeon's left forefinger should follow the retreating knife and cover the place of entry, permitting no oozing out of blood or entry of air, until he has covered the part with a small dossil of lint and secured it with a light turn or two of a roller bandage. Although we have operated on a large number of cases close to the clavicle, owing to the former belief that it was preferable to sever tendinous rather than muscular tissue, the present more promptly and neatly done section, not *à deux temps*, with a small knife in the middle of the neck, leaving no appreciable scar, offers the greater advantages.

In young and flexible subjects, we have found adhesive plaster and a common roller-bandage an amply sufficient mechanical contrivance to aid in rectification of the head. Apply a long strip of adhesive plaster around the forehead and occiput, its maintenance in position being better secured by a bandage passed over the vertex and beneath the chin, the two being pinned together where the one passes over the other, above the ears. Next attach around the waist a broader band of adhesive plaster, not so tight as to interfere with the movements of the ribs; over this a turn or two of calico roller-bandage; the two should be fastened together by a stitch here and there. The surgeon has now two circular bandages, the one around the

forehead, the other around the waist, which are not likely to slip if properly applied. He then should sew a strip of tape to the head bandage directly above the ear of the unaffected side, and carry it diagonally across the trunk to the opposite side of the waist bandage, and there pin it. By this means the left mastoid process (we are speaking of wry-neck caused by contraction of the right sterno-mastoid) will be drawn towards the right sterno-clavicular articulation, the original wry-neck be removed, and the chin brought to the median line, or in young and flexible subjects even across it, towards the affected side, constituting a temporary wry-neck in the opposite direction. The circular or ovoid form of the cranium renders it difficult to act upon it for any length of time by any other apparatus hitherto invented. The apparatus will shift its direction, or rather the head will partially disengage itself. Hence even a greater necessity for manipulations exists in congenital wry-neck than in other deformities. No apparatus effects so beneficial and lasting an impression upon the distortion as that which can be effected by the hands of the surgeon or attendant. There is a great additional advantage in the patient being freed from the burden and annoyance of the complicated apparatus often recommended. Whilst sitting in front of the patient, the attendant should be taught by the surgeon to apply firmly his flat hands to the sides of the head, and direct the chin, vertex, or occiput in the required directions. The patient should be placed on a lower seat. Such manipulations need to be done with due caution and technical skill. It is not necessary to cause pain in order to produce much good. They should be employed three or more times a day. The plaster and roller-bandage which we have described is most convenient in reference to these manipulations. It may be unpinned in a moment, and as quickly readjusted. We have cured many cases by the means here enumerated, in periods varying from one to three months, and have only once had occasion to repeat the operation, because in that case we had left a portion of the clavicular origin of the muscle unsevered. It is not always easy when dividing separately the clavicular portion to determine whether a few fibres of undivided tense structures be muscle or fascia. It was this case which, at the second operation, induced us to revert to the old operation in the middle of the neck. Manipulations as a precaution against relapse may be longer resorted to; but the patient's voluntary efforts are more employed, for obvious reasons, and are more successful, than in some other congenital deformities.

When the patient is old enough the surgeon will find the greatest assistance in encouraging the patient to sit before a looking-glass, to hold the head straight, and practise all the natural movements with accuracy. It is lawful to excite the proper pride of the individual by such gymnastics. An apparatus similar to that generally resorted to for rectification of the position of the head in deformity from vertebral disease, may be employed in cases of *adult* congenital wry-neck during some portion of every twenty-four hours. It readily effects re-position of the lateral or forward inclination of the head, but is powerless to affect the abnormal rotation of the head round the horizontal axis.

Wry-neck from contraction of clavicular position only of the sterno-cleido-mastoid.—In a few cases of congenital wry-neck we have found the sternal portion or the clavicular portion alone contracted; in these instances we have severed the single contracted origin, the cases having done well.

Acquired or non-congenital spasmodic wry-neck.—We have seen many cases of active, violent spasm of the sterno-mastoid in both sexes, oftenest in unmarried females of middle and advanced age, causing severe wry-neck (see fig. 32). The spasm is commonly jerking, irregular, convulsive, never ceasing entirely whilst the patient is awake. The disorder has usually commenced a few years before or after the age of thirty in subjects not always obviously hysterical, persons of excellent intellectual and social characters, whose families have seemed prone to other cerebro-spinal affections. We have watched several of these cases for many years. The spasm and deformity have in many cases gradually increased, often rendering the patient's existence distressing, through incessant motion of the head, disturbance of sleep, and pain in the neck, apparently due to strain of ligaments and nerve-dis-

turbance, and sometimes accompanied with pain referred to the upper part of the spinal cord itself, as in some cases of 'spinal irritation.' Now and then the spasm is so considerable that the ear of the affected side is drawn down by a series of jerks so as almost to touch the clavicle. The patient's voluntary efforts to arrest the pulling down of the head appear to increase the disorder. Sometimes the co-existent affection of the trapezius draws the head at the same time backwards, and prevents the chin approaching the sternum. In inveterate cases, such as have existed many years, we have employed mineral and vegetable tonics, galvanism, and electricity, with only temporary benefit. However, as might be expected, generous diet, hygiene, and freedom from mental disturbance, alleviate the symptoms. Complete relief is afforded by subcutaneous section of the affected sterno-mastoid; but even this measure is only useful for a time; for after two or three months, or as soon as reunion of the severed part is complete, the spasmodic shortening and jerking return. Stromeyer had a patient who submitted to two repetitions of tenotomy for the sake of the temporary relief afforded by the operation. The author once operated on an elderly female who had suffered from spasmodic wry-neck upwards of twenty-five years. She had been unable for many years to sleep in the recumbent position, but dozed in a high-backed nurse's chair, provided with side-supports for the head. For a few nights after the operation she slept soundly in bed. The malady, however, returned, and two or three years afterwards she sank exhausted, want of sleep appearing to be a principal cause of the fatal result. The operation on the sterno-mastoid is insufficient to affect the remaining muscles, which are sometimes involved.

In two recent cases of this affection, such for example as have existed less than two years, we relieved the patients in a few months, using bromide of potassium with quinine and other tonics. In others the use of the perchloride of mercury has had the most satisfactory effect. In every case which the author has cured, using internal remedies, the value of attention to the primæ viæ has been apparent. For this purpose, half a grain of the ext. aloes barbad. every night has been used. The utility of hydr. perchlorid. and of argent. nitr., in these and analogous cases, may be due as much to their stimulant action upon the hepatic and alimentary mucous surfaces, as to any specific action upon the nerve-tissue serving the implicated muscles. Relapse is not uncommon after every mode of treatment.

An interesting instance of almost perfect cure of an inveterate case in which mere section of the sterno-cleido-mastoid had proved only temporarily beneficial, is fully recorded by Mr. Campbell De Morgan in the *British and Foreign Medico-Chirurgical Review*, July 1866. The successful operation consisted in division of the external branch of the spinal accessory and the removal of a piece of the nerve, about a quarter of an inch in length. The patient was seen some two years afterwards with only faint traces of the disorder.

In obviously hysterical wry-neck in the young female, even of only a few months' standing, and which might have resulted from emotional influences—a condition which we are unwilling to term mimetic, for we could not learn that she had ever seen a similar case—a judicious amount of sympathy, for the pain which really exists on the side opposite to the contraction, combined with the assurance of possible cure, by her own exertions in front of the looking-glass, and a little good-natured banter on the improvement in appearance, on holding the head straight, even for a moment, many times a day, result in the acquirement of increased strength by the will and the normal muscles. These gymnastic efforts undoubtedly greatly help, if they do not wholly effect recovery, when supported by the infused belief in ultimate cure. We may here state that we have never met with a decidedly hysterical case of foot, limb, spine, or neck deformity in the young which did not finally recover. They differ widely in this respect from the older spasmodic cases, occurring about the climacteric period.

Paralytic wry-neck is rare; we have not seen more than three cases. The head is drawn to one side by the healthy muscle, which is deprived of its antagonist. In paralytic wry-neck, when the stage for ordinary treatment of the partial paralysis has passed, we can do no more than support the head by the padded leather or steel-

spring cravat. Except when the unparalysed sterno-mastoid is structurally degenerated or very rigidly contracted, and is insusceptible of elongation by manipulations or mechanical treatment, it would be as irrational to employ tenotomy as it is in a case of contracted gastrocnemius, which has simply lost its antagonist, and which can be relieved by a suitable mechanical support without operation.

Wry-neck from disease of the cervical vertebræ is caused by strumous, and sometimes by rheumatico-strumous disease of one or more cervical vertebræ, from which the head inclines to the affected side. The chin is directed to one side. In bulging of the opposite side of the neck, and in general appearance, these cases much resemble congenital wry-neck, but are distinguished from it by their history, the pain on motion, the aspect of strumous or constitutional disorder, sometimes by hectic, by the instinctive aversion of the patient to the surgeon's handling of the head, and concomitant glandular or other forms of strumous disorder in one case, or rheumatic affection in the other. The pathological changes common to disease of the vertebræ in each region, and its peculiar dangers when situated in the neck, are described in a subsequent essay. Great caution is necessary in handling these cases, lest the disintegrating bones give way suddenly to the pressure, or the reparative process which may be going on be interrupted. Much benefit to the disease itself, and gradual improvement in the position of the head and neck, and even rectification, may be effected by a well-adjusted apparatus, as well as by the recognised medicinal, dietetic, and hygienic treatment of the constitutional malady. We have twice witnessed death, as sudden as in apoplexy, in cases in which suitable support of the head had been neglected, and the patients had persisted in maintaining the erect position, having walked about supporting their heads with the hands. These cases are analogous to death from sudden and quickly fatal paraplegia in cases of advanced disease of dorso-lumbar vertebra in which absolute recumbency had been neglected. An efficient apparatus consists of a padded metal plate, secured by straps beneath the axilla and around the chest upon the shoulder of the side to which the head inclines. From this shoulder-pad an iron upright piece extends upwards, by the side of the neck, to the parietal region. The lower end of this upright is attached to, and moves upon, the shoulder-plate by means of an endless ratchet-screw; the upper end is connected with a pad intended to be adjusted and pressed against the parietal region. In adults and very severe cases, this apparatus may be attached to a common spinal support for the chest and pelvis, for the sake of greater fixity and more powerful leverage. Sometimes an iron stem is required to extend upwards to one or both sides of the head, with connecting straps to be applied beneath the chin and occiput, so as to receive the weight of the head. We do not commonly find it necessary to employ the cumbrous and unsightly machines, consisting of an iron scaffold and gibbet for suspension of the head, to which surgeons resorted as lately as the commencement of the present century.

Knock-knee, In-knee (Genu valgum).

Genu valgum is an alteration in the form and relation of parts of the knee-joint, which is apt to accompany the majority of disorders to which the joint is liable. There are therefore almost as many clinical varieties as there are knee affections, and the distortion may also arise in the overladen, and overworked, but healthy knee.

In-knee has commonly been treated of under two heads: (1) *the Statical*, caused principally by the action of gravity; (2) *the Rachitic*, in which softening of the bones and relaxation of the ligaments and muscles have been the primary causes. It is, however, obvious that, if the subject of such relaxation and softening attempts to stand erect or walk about, statical influences will come into play as much as in those cases called statical.

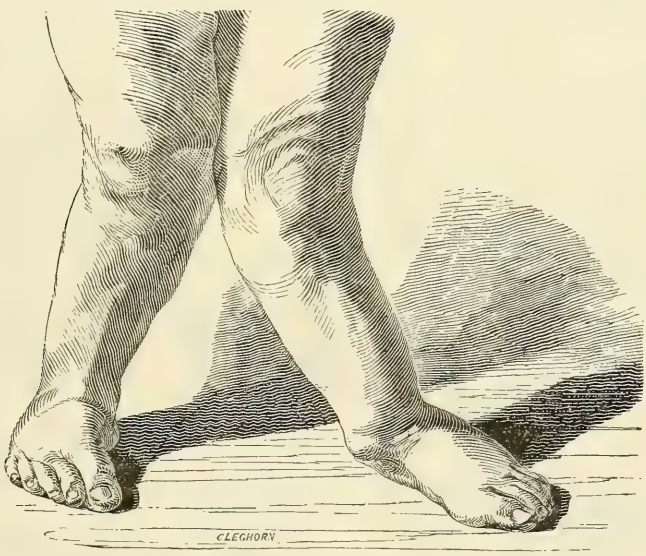
Genu valgum may exist in slight degree at birth, may originate in the fast-growing year-old infant, from want of breast milk, or from improper and too-watery diet, without external signs of rachitis; or it may depend upon unequivocal rachitis, upon infantile paralysis, upon ordinary spasm from cerebro-spinal disease, or that

which follows asphyxia neonatorum. The non-rachitic form arises less frequently in the later years of childhood during convalescence from any of the acute disorders of that period, when the patient is too soon allowed to stand and walk. On the approach of puberty in both sexes during another period of fast growing, say from the twelfth to sixteenth year or later, a liability to the non-rachitic distortion occurs, increased in the labouring classes by overlading and over-exercise of the limb, and the respiration of the deleterious atmosphere of the workshop. At any period, injuries as well as white swelling (strumous synovitis and ostitis) are apt to present, besides subluxation and contraction in the flexed position, a marked inward inclination of the knee, with eversion of the leg. This is also true of rheumatic knees, especially in chronic cases.

We have seen considerable in-knee in tall, robust, over-stout and overgrown adolescents and adults, height and weight having equally contributed to it.

This greater liability to genu valgum rather than to the opposite deformity (genu extrorsum) is determined by the natural form, relations and functions of the parts. In a sound knee, the active and passive structures, the moving and resisting forces are so balanced, that while the normal relations are preserved, a large capability of use beyond the average limits exists.

Fig. 33.—Genu Valgum from Rachitis; one foot being inclined to Valgus, the other to Varus.



In-knee has been directly attributed to the normal greater size of the internal condyle, to the normally adducted position of the femur, to the asserted naturally less developed condition of the outer articular surface of the tibia, to the known greater normal range of abduction of the leg over adduction, in some positions of the knee, and lastly to abnormal contraction of the biceps muscle.

These circumstances favour the production of in-knee only when morbid alteration of the parts concerned in the joint, intrinsic and extrinsic, from overwork, or any of the forms of knee affection, exists. When, therefore, the surgeon treats the early stages of a disease apt to be complicated by knock-knee, he can, by suitable treatment, prevent its occurrence.

Symptoms.—Inclination of the knee inwards is easily recognisable in all its stages, from the slightest departure from the normal, in which the inner ankles, when the patient lies supine, are separated only two or three inches, or one knee when erect slightly overlaps the other, to the more considerable deformity, in which, as fig. 33 shows, the feet are separated ten or fifteen inches. When the surgeon places one hand against the inner aspect of the knee, and the other against the outer malleolus

in a young child, he will in most cases, by gentle handling, straighten the limb, and will note that a considerable undue 'play' in the horizontal direction exists. When thus straightened, he can almost insert his forefinger into the gap formed between the external condyle and the upper part of the tibia (see fig. 34). The extent of this gap is a measure of the extent to which the weight of the body acting on the relaxed and softened structures has altered their relation to one another at this part, causing knock-knee. This gap is much more obvious and greater in atonic or non-rachitic 'statical' cases than in rachitic cases, because the joint is in the latter less lax; it is even sometimes imperceptible, because the softening of the bones in rickets may allow the articular surfaces to mould themselves to one another, and even in children three years old the knee-joints may be comparatively firm and unyielding.

In older neglected cases of in-knee, with little or no traces of rickets (see fig. 35), the ankles may be separated more than twenty-four inches, walking, however awkwardly, being almost impossible. A remarkable feature of the distortion is that it disappears when the knees are flexed, the joint structures being then relaxed. Hyper-extension of the joint accompanies knock-knee, especially the undoubtedly non-rachitic form. It has never before been pointed out that in young rachitic

FIG. 34.—Schematic representation of Genu Valgum.

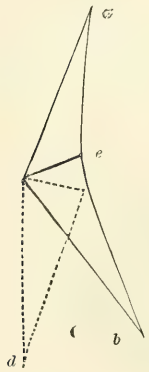


FIG. 35. — Extreme Adolescent Idiopathic or Atonic Knock-knee.

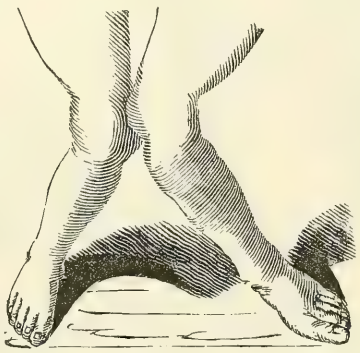


FIG. 36.—Considerable rachitic Genu Valgum, due in reality mainly to great curvatures of femur and tibiæ; from A. Meyer.

a, the femur; *b*, the tibia; *c*, the projecting knee-joint; *d*, dotted lines representing the tibia placed in its natural position; *e*, gap on the outside of the joint.

knock-kneed children, the reverse of hyper-extension—viz. deficient extensibility—exists, with which the surgeon may have to deal, as well as with curvature of the shafts of the bones and inward inclination of the knee in the same limb.

Sometimes the so-called genu valgum in rachitic subjects is due, as in fig. 36, more to curvature of the shafts of the bones than to disturbed relation of the parts of the joint itself.

In fact, we find that many of the cases regarded as rickety genu valgum, successfully treated by osteotomy, have not been rachitic according to our definition of the term (inward yielding of the knee-joint), but indiscriminately either statical, non-rachitic ones, rachitic ones, or cases of curvature of the shaft causing apparent knock-knee.

When the bones, from a case of severe genu valgum, are disarticulated, and placed as in the normal limb when the body is erect, the gap just alluded to is seen as a triangular space between the external articulating surfaces, the base of which may measure from $\frac{1}{4}$ to 1 inch, according to the severity of the case.

This gap constitutes the grave anatomical fact which the surgeon in the treatment of the majority of cases has to keep in view.

Treatment of knock knee.—We have heard it maintained that, as a rule, children recover spontaneously from this affection. In a small proportion of cases, spontaneous recovery of good power of walking takes place; but an examination of such instances has shown us evident traces of the affection in some persistent projection of the internal condyles, with inability to take long walks on several successive days, without weakness and pain on the inside of the knee. Slight cases will recover under improved dietetic and hygienic influences, with the aid of suitable manipulations, and the discontinuance of prematurely urging the child to walk. Sometimes we can, in addition, advantageously recommend the recumbent posture during certain short periods of the day, and combine with this repose the placing a soft pad between the condyles, the limbs being extended, and the ankles being gently drawn towards each other by means of a soft bandage, strap, or other ligature, or by the hands of the surgeon or of the 'rubber' who has been taught by him (see figs. 37 and 38).

Long-continued experience has shown us that two things are indispensable—viz. to

FIG. 37 represents a moderate degree of Knock-knee in the act of manual reduction. If the surgeon prefer, he may teach the rubber to accomplish the same upon each knee singly, by pressing the internal condyle with one hand, and the outer malleolus with the other.

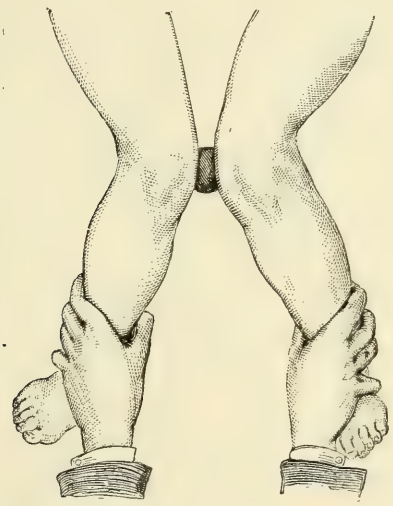
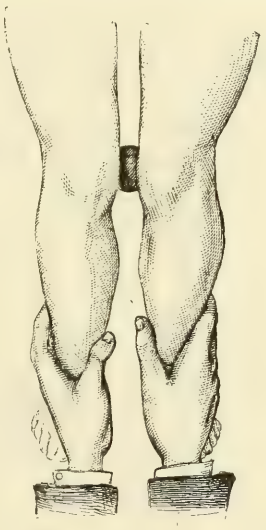


FIG. 38 represents the same Knees as fig. 37 when straightened with the hands. During these manipulations it is absolutely necessary that the patellæ should present upwards, towards the ceiling, not sidewards.



keep the knee extended during active treatment by an unyielding padded splint of any material along the back of the joint to prevent its bending, and to apply a similar contrivance along the outside of the joint to maintain *adduction* of the leg.

The *side* splint should be thickly padded along one-fourth of its length only at both extremities, leaving the middle portion unpadded so as to present a hollow into which the joint may be drawn by a roller bandage or straps and buckles (see fig. 39). Should the case be more severe than in the above figure, or any difficulty be experienced in accommodating a flat straight back splint to an inwardly inclined knee, a light wood or metal splint (fig. 40) may be employed; being articulated horizontally, it accommodates itself to the angle of the distorted knee, but effectually prevents bending, and does not interfere with the action of the side splint. We prefer these splints to the metal troughs furnished with straps and buckles which we introduced a generation ago.

Children of the well-to-do classes with slight knock-knee may, with or without the use of splints, at night, and some two or three hours in the day-time, spend a part

of their day at book or needlework, sitting on the ground with knees crossed, and their work in front of them. Every occupation that frees the outer side of the knee-joint from pressure is desirable. Pony or donkey exercise astride without stirrups when available, very useful.

Fig. 39 represents the Side Splint along the outside of the knee before the roller bandage is applied. The plain straight *back* splint, which should be applied before the side splint, is not represented here.

Fig. 40.—Dr. Little's improved Articulated Back Knee-splint for instrumental treatment of In-knee.

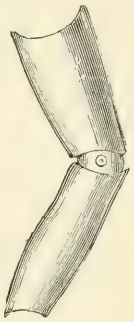


Fig. 41.—Diagrammatic representation of Walking and Night Instrument for rectification of severe Adolescent Knock-knee. It consists of an upright stem, with free movement joints at hip and ankle, attached below to an ordinary foot-piece, and transferable to an ordinary day boot, to which it may be secured by a spring below the heel.

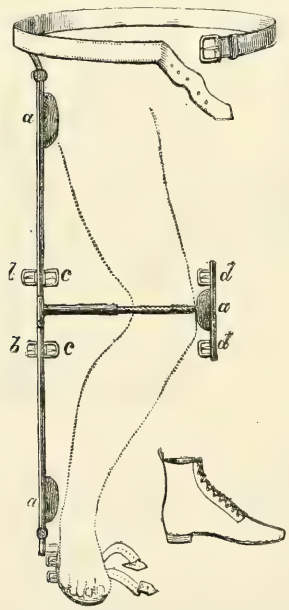


Fig. 42.—Right In-knee, with hyper-extension and out-knee on the left side, with general outward curvature of the limb. From Macewen, 'On Osteotomy.'

a a, on the upright stem are pads on the fulcra to protect the skin over the trochanter and the external malleolus from pressure; *a*, on the inside of the knee, is to indicate a pad to protect this part from pressure. Leading from this pad to the upright stem is a metal back-piece, consisting of two parts, the left-hand half being the female screw, and the right half a male screw. By turning round the piece of metal *a*, to which the male screw is attached, this is made to enter the female screw, so that gradually the pad *a*, opposite the inside of the knee, is approximated to the upright stem, and the inverted knee-joint gradually directed towards the perpendicular. To avoid encumbering the drawing several adjuvant essential contrivances have been omitted. These are a thigh strap, which should be attached to the upright stem, opposite the middle of the thigh, to draw the thigh towards the perpendicular; a similar should be opposite the middle of the leg. Besides these a stout buckskin strap should pass from the upright at *b b*, successively over the front, the inside, and around the back of the knee, and be buckled on the upright at *b b*, so as to draw the knee outwardly; and another buckskin strap pass from the buckles *c c* to the buckles at *d d*, so as to keep the knee completely extended. It is desirable that once a day the knee in the still-growing individual be bent, so as to avoid stiffening of the joint in the extended position. It is well to order the apparatus to have a ring-catch knee movement. If the knee of the worst class, whether or no section of biceps femoris has been done, be, as it should be, straightened within eight or ten weeks, the patient may be allowed, by means of the ring-catch, to walk with free movement of the joint a part of, or after a time, the whole day.

Infants even who are unable to walk evince no pain or inconvenience from treatment. If the utmost gentleness be used, nature will do her work in filling up the gap between the external condyle and opposite part of the tibia ; and certainly, on removal from the joint of the undue direction and pressure of the weight of the body, the ligaments and muscles will adapt themselves to the new order of things. With improved nutrition infantile cases are remediable within two or three months, not needing afterwards irons or retentive apparatus of any kind. Children of two to four years and upwards able to walk, if the case be more severe, may wear the apparatus (wooden splints or common leg irons, with or without 'ring catch' arrangement, as the necessities and severity of the case may indicate) day and night, and walk about in the day-time with reasonable rest, the apparatus being removed morning and evening for cleanliness sake, and to enable the nurse to bend methodically the knee-joint once or twice, *i.e.* preventing inversion. Patients may follow their nursery school or business vocation. As soon as it is found that the knees evince no decided tendency to return to the valgus form, directly the apparatus is removed, a gradually extended permission to habitually use the limb in full mobility may be given.

A tall adolescent may be successfully treated throughout by the splints at night, and a long straight iron outside from pelvis to the ground, not jointed at the knee, during day-time. It is rarely necessary in any but the severest neglected or unrelieved cases, even in the adolescent up to the age of 16 or 17, to confine the patient to couch or bed, to resort to tenotomy, division of ligaments, or to forcible straightening under anæsthesia.

If force be absolutely necessary, we prefer supra-condylar osteotomy, especially as carried out by Macewen, remembering that the division of bones is rarely required for the relief of the essential nature of the knock-knee joint distortion, but only for the otherwise insuperable rachitic coexisting curvature of thigh and leg bones ; in fact, for relief of severe rickety curvature in advanced adolescence and adult age, to which it should, in our opinion, be restricted. (See the section on 'Osteotomy' in the essay on Surgical Diseases of Childhood, Vol. III.)

Occasionally the knee-joint yields outwardly instead of inwardly, constituting a deformity exactly the opposite to knock-knee (see fig. 42). We have named this affection, *Genu extrorsum curvatum.* The treatment of it should be conducted upon the same principles as that of knock-knee, but be applied in the opposite direction. Sometimes we have to treat in one limb genu valgum and in the opposite limb genu extrorsum curvatum, the latter being the more obstinate under mechanical treatment, and therefore needing earlier recourse to osteotomy of thigh and leg bones.

Anchylosis of the Knee and other Articulations.

The successful labours of orthopædic practitioners have contributed to improve the knowledge of the real condition of joints after the cessation of various forms and degrees of injury, inflammation and degeneration. The erroneous notion, that long-continued repose of a joint alone sufficed to induce such alterations in its articular surfaces as to lead to bony union, and the remarkable rigidity and immobility which result from the agglutinated or contracted extra-articular structures—fasciæ, muscles, and ligaments—especially when dense, fibrous, deeply-extending cicatrices co-exist, favoured the supposition of the common prevalence of true bony, irremediable anchylosis. We know that absolute bony union of articular surfaces is a comparative rarity, even in pathological cabinets.

For practical purposes we may divide the conditions in which joints contracted from disease are presented to the surgeon, with a view to the restoration of form and motion and restoration of symmetry, into three classes. 1st. Those in which the resistance to motion is furnished solely or mainly by shortening of the extra-articular tissues. 2nd. Those in which, in addition, more or less considerable changes in form and relation of parts of the articulation, in consequence of subluxation or partial dislocation of the articulating ends of bones, has occurred. 3rd. Those in which more or less considerable changes within the joint have occurred, viz. transformation

of the synovial surface, vascular adhesions, fibrous adhesions, erosion of cartilage or of bone, mineral or bony deposits. 4th. Absolute osseous anchylosis.

The first class of cases is common. We have met with numerous instances of knee and elbow-joint contraction, induced respectively by severe, deeply-extending burns, by phlegmonous erysipelas, by 'swelled leg,' in which the history of the case, the state of obvious contraction and adhesion of the extra-articular tissues, together with the absence of displacement or deformity of the articular extremities of the bones, left no doubt in our minds that the articular surfaces, notwithstanding the paucity of motion, or its entire absence, were free from organic change. In these cases, restoration of form, and often an almost complete recovery of spontaneous, *i.e.* voluntary movement, may be effected without difficulty.

The cases in which more or less luxation of bones exists demand greater attention during treatment than those in which abnormal flexion alone exists. The subluxation is often accompanied with abduction of the tibia and consequent genu valgum (see section on this knee deformity).

The third class of cases includes some which have had a similar origin to those of the first category, but in which the injury or inflammation has extended to the interior of the joint, or at least has involved the capsular ligament. In these cases, deep, retracted, indented cicatrices, and bands of indurated adventitious tissue, penetrating, it may be presumed, into the hollows and sinuosities of the ends of the bones, even if all happen to be exterior to the articulation, tell of exposure of the synovial membrane so near to the disease, that it is improbable that it will have escaped. These cases admit of rectification of position, and commonly some degree of voluntary motion follows. The bulk of this class consists of cases resulting from strumous synovitis (?) and diseases of the articular extremities, rheumatic and gouty contractions, and distortions from accidental violence.

The strumous distortions of the knee usually present considerable mobility within a limited range, with much deformity and prominence of the internal condyle from subluxation, inversion, and from wasting of the member above and below the articulation. They are usually straightened without any great difficulty, although much prominence of the condyles and displacement may remain unless guarded against. Partial mobility is usually recovered.

The rheumatic cases which apply for orthopædic relief are principally of two kinds, those in which 'chronic rheumatic arthritis' subsists, and those rarer instances of acute articular inflammation excited by exposure to cold during gonorrhœa, childbed, or an early stage of lactation. In the first kind, during the comparatively early stage, much intra-articular fluid secretion and free mobility within a certain range remain. At a later stage, in proportion to the development of gelatinous and vascular adhesions and mineral deposit, the movement becomes more limited. In ordinary rheumatism, true anchylosis does not occur. We have been long accustomed to attempt, by gentle manipulations and gentle but firm employment of mechanical contrivances, to restore these limbs to greater usefulness as regards movement and symmetry. We have succeeded in obtaining the latter, but not the former desideratum. In fact, as might be inferred from pathology, the benefit of orthopædic treatment is in the inverse proportion to the anatomical degeneration which the rheumatic joint has undergone.

In the second kind of rheumatic cases of partial anchylosis, those which have commenced with very acute affection of one joint, most often the knee, the loss of motion occurs rapidly, and is frequently complete. It seems, in these cases, that an acute destruction of the synovial surface, with rapid exudation of mortar-like plastic material, takes place, causing firm agglutination of the ends of the bones.

Tact in the examination will usually show that absolute immobility of the knee, from whatever cause the anchylosis has proceeded, does not exist. The joint is movable when a gentle and unexpected effort to bend or straighten the limb produces a sharp pain through it. We deduce some favourable conclusions as to the state of the joint if we find the patella movable. This bone may sometimes be moved upon its horizontal axis when no motion is perceived upon the perpendicular one, and

when no flexion or extension of the knee can be effected by ordinary handling of the joint.

Articular rheumatism, acute and chronic, usually leaves the synovial membrane intact, no deformity, as a rule, remains, the exception being in the knee and ankle; here the weight of the body comes more mischievously into play than elsewhere, and sometimes gives rise to a rheumatic genu valgum, and in-ankle or flat-foot.

Many rheumatic contractions, those which are the least amenable to treatment, belong to the peculiar form of the disease denominated 'chronic rheumatic arthritis' by Adams of Dublin, the 'rheumatoid arthritis' of Garrod.

In reference to treatment and prognosis, a correct judgment of the condition of a joint contracted from disease may be formed from the history and the external appearance, aided by careful manual examination. In the hip, the diagnosis is sometimes more difficult, because the history communicated may be fallacious in consequence of the greater liability to errors in diagnosis during the first stage of disorder in and around this articulation. Hip-contractions occur in which the primary hip-affection had been originally 'sciatica,' muscular and fascial rheumatism of the bulk of the muscles of the hip and loin, or one of the forms of rheumatism of the joint itself, or 'morbus coxæ,' or the result of accident. To these causes of hip-contraction, which are not always diagnosed, we may add the peculiarly grave intra- and extra-articular exudation which occasionally occurs at the close of malignant scarlatina, and the less serious persistent drawing up of the thighs which occurs (without pyæmia) during a tedious confinement to bed from fevers and phlegmasiæ, especially in persons whose growth is not complete. We have also met with severe rigid hip-contraction, with pain and wasting, which had commenced during pregnancy from uterine influences; also after childbirth from puerperal disturbance; and in unimpregnated, as well as in unmarried women, even from great fæcal accumulation in the intestines. Whilst reminding the surgeon of the various causes of persistent hip-contraction, we may complete the list by adding congenital and neo-natal contractions and luxations, paralytic and spasmodic contractures, some of these being hysterical, and some very grave affections, proceeding from disease of the brain or spinal cord, sometimes co-existing with angular spinal curvature. These numerous causes of hip-contraction are not enumerated as if they were so many pitfalls to the surgeon; but in order that, knowing what may have produced a given contraction, the young surgeon may be forearmed for diagnosis and successful treatment.

Treatment of partial and complete anchylosis.—The several forms of contracted joints of the extremities above enumerated admit of four modes of treatment: 1st. Mechanical extension, including manipulations and shampooing. 2nd. Tenotomy, succeeded by gentle, gradual mechanical extension. 3rd. Violent extension under the anæsthetic influence of chloroform, sometimes preceded by tenotomy. 4th. Osteotomy.

The majority of joints affected with incomplete anchylosis, even the knee, elbow, or hip, still more the smaller articulations, and even after three or four years' duration of the contraction, admit of as full and prompt restoration by gradual, gentle employment of mechanical extension as by either of the remaining modes of treatment above indicated, with the advantage of the treatment being conducted without pain, suffering of any kind, or confinement to the house. In severe knee cases of many years' duration, subcutaneous division of the hamstring muscles may advantageously precede the mechanical treatment, the surgeon bearing in mind that here, as in other distortions, success depends more upon the manner in which the mechanical treatment is conducted than upon operative interference (see p. 268). In a small proportion of cases, those in which apparent total immobility exists, or in which it is obvious that partial calcareous deposit has taken place, violent extension, with the aid of chloroform or ether, may be employed.

Mechanical extension of partially anchylosed joints.—Little actual apparent power is required to overcome the most rigid cases. The first condition of success is the correct adaptation of the appropriate apparatus to the size and natural move-

ments of the part, and to the departures of the limb from the natural form and direction, remembering what has been said (p. 267) as to the combination of genu valgum with abnormal flexion from disease. When practicable, the apparatus should only limit the movement of the affected joint towards the contracted side, *i.e.* it should not immovably fix the part in every direction, but should leave some 'play' to the limb in the direction which it is wished the part should take. No curable anchylosis, free from bony union, can resist gradual, gentle pressure; we only resort to tenotomy in addition to mechanical extension for the purpose of saving time. A little consideration will explain how apparently slight continued pressure can effect so great a result as the straightening of a knee contracted for more than twenty years from former articular disease or injury. The uninitiated surgeon is accustomed to regard such a joint as 'nearly anchylosed;' perhaps he does not reflect that if bony union has not taken place, the opposing structures are 'soft parts,' *i.e.* shortened muscles, ligaments, fasciæ, cutaneous textures, and cicatrices, all liable to yield to steady pressure. It is probable that as soon as this gentle pressure is applied, the contracted muscles, shortened merely from position and repose, *not being spasmodically affected*, resist elongation, but they speedily tire, and give up the unequal struggle; the non-muscular parts, however dense they may be, probably undergo some change of vascularity, some interstitial change in their nutrition as a consequence of the *gentle violence* they undergo through which their mechanical power of resistance is diminished. An increase of temperature and of bulk of the part undergoing too rapid mechanical extension is usually perceived, which we believe to be due to increased flow of blood consequent upon the stimulus of the state of tension in which the resisting tissues are maintained. This augmented flow of blood is unaccompanied by inflammation or even by pain when the part is at rest. Such appears to be the process in the structures on the contracted side of the member. The treatment probably receives aid from the muscles on the uncontracted side. The direction of the distortion was originally determined by the stronger set of muscles, or by those most advantageously situated, having overpowered the weaker set. When the contracted muscles yield in their turn to the mechanical instrument, the muscles situated on the uncontracted side tend to recover their lost sphere of action, and assist replacement.

At the knee-joint, the thigh and leg each offer a great length of leverage, advantageous for successful treatment by mechanical extension; and consequently we have met with no partially anchylosed knee which has not been straightened and rendered fit for use without the aid of tenotomy or chloroform in a period varying from one to three months.

The anatomical relations of the hip-joint render it, as already mentioned, less favourable for orthopædic treatment than any of the ginglymoid articulations. We may mention, in illustration, that in an instance of uniform fibrous and vascular membranous adhesion of the head of the femur within the acetabulum after death, the partially anchylosed pelvis and thigh having been removed from the body, we were unable to extend the hip by any power we could exert with our hands, until the capsular ligament and some of the adhesions within the acetabulum had been severed with the knife. The same kind of adhesions in a knee would have yielded to the power fruitlessly employed at the hip.

The continued attention of orthopædic practitioners who, during the last five-and-thirty years, have trodden in the footsteps of Scarpa and Stromeyer, bringing pathological and anatomical knowledge with experience to the aid of the instrument-maker, has revolutionised, simplified, and thus far perfected orthopædic apparatus. When practicable, elaborate instruments should be avoided. In numerous instances, as in congenital club-foot of adolescents, in considerable knee-contractions, and subluxation, the necessity of well fixing one part whilst another is acted upon, or the complicated character of the deformity itself, entails corresponding need of an elaborate contrivance.

Different mechanical forces are employed—the lever, the screw, and the spring; the last two often resolvable into the lever, screws and springs being employed to

modify the action of the lever. The discussion of the relative advantage of the different modes of applying these forces would lead us away from our immediate object.

It should be borne in mind during the employment of these forces in orthopædic apparatus, and especially in the use of the screw, that it is available less as a means of abruptly forcing the deformed parts into their natural position than as an adjusting contrivance. In any case in which the screw is *forcibly* employed, excoriation, sloughing, or intolerable pain, will inevitably result. In some *patient* individuals, vesication, and even superficial sloughs, may be induced over projecting bones without complaint of pain—an urgent reason for anxious examination of a part subjected to pressure, especially by the inexperienced orthopædist. Large sloughs are more than inexcusable.

Every apparatus should be padded, so as to avoid pressure upon prominent points of the bone, and adapted to each individual case. The orthopædic apparatus, like that for a fractured limb, should compress the part in its circumference as little as possible, and never tightly encircle it. It should act gradually, *in proportion as the deformity itself changes in degree.* A simply contracted knee resting upon its posterior aspect in an apparatus slightly straighter than itself, tends by its own weight to regain a straighter position.

The greater number of contracted joints, when not affected with bony anchylosis, if left to themselves, may be regarded as contracting joints; for the contracting process is ever progressing until it attains the maximum.

At the outset, the surgeon should be content almost simply to apply the instrument to the deformity, and not to apply the deformity to the instrument, as is too often attempted by novices. In this gentle manner of proceeding, the first difficulty in the treatment of every case of deformity is overcome,—the patient suffers nothing from the attempt to straighten the part; the simple inconvenience of wearing an apparatus, the irksomeness attendant upon necessary confinement of the affected part in an unfamiliar instrument, is his only trouble, and one which is speedily, in a day or two, overcome. Having once applied a well-fitting instrument, the screws or straps by which it is adjusted to the now improving member require to be advanced or tightened as opportunity offers. An impatient advance of the pressure will, by production of pain, and necessity for relaxation of the instrument, occasion loss of time. The principle of action in the progress of mechanical treatment should be that of never advancing too rapidly, so as to risk the necessity of receding. By gentle steady advance, the patient's confidence, so essential to prompt recovery, remains undiminished. By subjecting the member to no greater pressure than can be easily borne, no temptation to loosening the apparatus is afforded to the timid, and no risk is incurred of occasioning excoriation or inflammation in individuals possessing greater endurance, or in young children, whose cries might by mistake be attributed to other causes. The surgeon, or a trustworthy attendant, must take due precautions that the patient does not play 'fast and loose' with the apparatus. In this manner, in suitable cases, the opposition offered to restoration by fasciæ, tendons, ligaments, and ill direction of articular surfaces, apparently irresistible, may be removed.

In the choice of mechanical apparatus the surgeon should also be guided by that principle which actuates him in the selection of therapeutic agents in any internal or external disease, viz. the use of that means the action of which he best understands, or in the use of which he has had most experience. A common splint, properly applied, will effect more benefit than an instrument of greater pretension indifferently managed.

We have straightened in a few months, or within a year or two, many rigid partially anchylosed hips, believed at first to be true anchylosis, without confinement in lusty adolescents, in whom the thigh had been several years bent more than a right angle, with corresponding great lordosis, the limb afterwards touching the ground with the help of a raised shoe, mainly needed on account of the wasting of the limb caused by the previous disease.

Much harm will result, in many deformities, from the practice unwisely pursued of keeping a deformed part many weeks in succession in an apparatus without the removal so necessary for the purposes of cleanliness and readjustment. Among the evil consequences of too long retention of instruments, often combined with unsuspected excessive pressure, the author has witnessed a degree of rigidity of the ankle, not previously rigid, which has required weeks of manipulations and stretchings, before the natural movements have been possible. Sometimes, indeed, as in the elbow, restoration of motion of an articulation has been rendered impossible.

The slighter the deformity, the more necessary is frequent removal of the apparatus, because by removal and appropriate manipulations we insure retention of mobility. In severe cases, in which we expect only to effect straightening, and do not anticipate restoration of mobility, frequent removal of the apparatus is unnecessary; for too frequent removal may be hurtful, by allowing the recently elongated tissues to recontract during the time the apparatus is removed from the part.

Division of the hamstring muscles.—In a limited number of knee-contractures from disease and accident, section of hamstring muscles may be required as a preliminary to gradual mechanical extension, or to abrupt violent extension under chloroform. In all cases after tenotomy, extension, whether gradual or abrupt, should be delayed until the healing of the punctures in the integuments. In the knee this healing is seldom complete until four or five days after the operation. The following rules may be given for severing the hamstring tendons: Place the patient in the prone position, and let an assistant make firm extension upon the joint, or, when anæsthesia is not employed, desire the patient to endeavour to bend the knee, by either of which means the tendons will be rendered prominent. In general follow the directions laid down for the division of the tendo Achillis (p. 238). In severing the tendon of the biceps femoris, insert the tenotome in the adult an inch above the apparent point of contact of the tendon with the fibula, remembering the proximity of the external popliteal nerve, and keeping, therefore, the tenotome close to the tendon. The semi-tendinosus being very superficial is readily severed by a puncture, where it springs up most prominently; the semi-membranosus being more bulky and fleshy, as well as more deeply seated, requires a larger sweep of the end of the tenotome. It is scarcely necessary to recommend caution as to the important nervous, arterial, and venous structures of the popliteal region. After section of the inner hamstrings, the pressure of the assistant's hands upon the limb being continued, bands of fascia and nerves make themselves prominently felt in the ham. Troublesome numbness of the calf, and unusual pain during extension, has followed the unnecessary division of these structures. It is desirable to apply promptly a pledget of lint and suitable pressure by a bandage over the punctures, to prevent oozing of blood into the areolar tissue of the ham, which affords an inconvenient nidus for suppuration. By adopting this immediate covering and pressure over the puncture, we have never witnessed delay in healing beyond four or five days, in ordinary moderate temperature. Very cold weather may cause tenotomy punctures in limbs of weak circulation to appear, at the end of several days, as if they had been effected an hour previously, no attempt at adhesion being made. It is therefore proper in cold weather to envelop the limb in flannel, and assist the reparative powers of the patient by generous diet.

Forcible subcutaneous separation of the tibia and femur in true bony anchylosis of the knee-joint.—This operation, originally proposed and carried out successfully by Langenbeck, and Gross of Philadelphia, was first performed in this country with some modifications by Mr. Little at the London Hospital, and has since been performed successfully by many surgeons. It has, as we surmised in the last edition, become a standard operation in surgery. The operation consists in making a small incision in the integuments and fibrous tissues at the side of the articulation, parallel to the plane of the natural articulating surface of the tibia. The length of this incision should correspond with the width of a narrow, sharp-cutting, well-tempered chisel or osteotome, bevelled on both sides, as recommended by Macewen, so as to

ensure its travelling in the required direction, say two or three lines in width, which being driven in different directions between the ends of the femur and tibia, which are united by osseous material, so effectually weakens the connection between the adherent surfaces, that straightening and bending of the limb can, with the exercise of 'gentle violence' with the hands, be readily effected. When the surgeon remembers that the *joint* has been destroyed by the diseased process which produced the bony anchylosis, he will not be surprised to learn that this surgical subcutaneous chiselling asunder of bones is not followed by any of the serious consequences known to follow, occasionally, wounds of the joint, and that with or without simultaneous section of knee tendons, as may appear requisite, the limb may be placed in the desired curative position. Osteotomy for relief of knees affected with *bony* anchylosis in a bent position, is in every respect preferable to the operation of knee resection, when it has been performed for mere anchylosis. (Section on 'Osteotomy' in the essay on the SURGICAL DISEASES OF CHILDHOOD, VOL. III.)

Division of muscles in the vicinity of the hip-joint.—Though in hip contractures the majority of the muscles proceeding from the pelvis on the flexed side of the part are contracted, experience teaches that few require operative interference. We have many times severed the origins of the adductor longus, adductor brevis, and pectineus, the tensor vaginæ femoris, and the superior origin of the rectus femoris. But of late years we have commonly restricted the operation to the tendon of the adductor longus, for the relief of tense abnormal approximation of the thighs, in cases of general spastic rigidity of the lower extremities. The adductor longus, from its position, exerts a relatively greater influence in morbidly adducting the thighs than other muscles. Its division is a satisfactory starting-point for subsequent benefit from mechanical exercises and use. It is effected according to the general principles of tenotomy, and requires no particular description.

Section of the tensor vaginæ femoris and rectus is suggested in certain cases of paralytic contracture of the hip, in which atony of the adductors of the thigh exists, a state of things opposite to the last-mentioned kind of case. Here the thigh is drawn from its fellow, the trunk tending to fall to the ground, as it were, between the thighs. Where contraction of these muscles exists, the paralysis of the adductors and other muscles of the hip (psoæ and glutei) is usually so considerable, that little radical good results from the operation. It should, therefore, as a rule, be superseded by manipulations, frictions, and mechanical appliances.

Division of the flexor tendons of the fingers and toes.—The phalanges, when contracted from articular complaints, require treatment similar to that of the larger articulations. Commonly it is the flexor tendon which is implicated. Enough has been stated concerning the large ginglymoid articulations to render many details of treatment of these small articulations unnecessary. In operating on the fingers, we have to consider beforehand whether the articular disease has left the joint in a condition to resume its function as to movement; for if we may not expect to recover mobility, a straightened finger is not preferable to one partly bent. The contracted flexor tendons of the fingers should not be severed opposite the phalanges, for as a rule adhesion to the sheath, and often a stiff, extended, useless finger results. See section on 'PALMAR AND FINGER CONTRACTION' (p. 254).

In the foot, the most frequent affections of the toes for which surgeons are consulted are those resulting from improper shoes worn during the growing period of the foot—in childhood and adolescence. The great toe is often thrust outwardly, and overlaps the next toe, the metatarso-phalangeal articulation being inflamed and ultimately deteriorated as to the normal condition of the articular surface, with consequent impairment of mobility and very troublesome lameness. The joint is inclined to stiffen in the extended position after subsidence of the irritation or inflammation, the individual being prevented standing tip-toe, or ascending a hill without pain or inconvenience. This condition of things may, before and about puberty, be remedied by rest and suitable topical applications, followed by manipulations; the interposition of a partition between the toes, so as to keep the great toe

in a proper line with the margin of the foot; and the temporary use of a suitably wide shoe. In long-standing cases, in which the extensor tendon of the great toe becomes rigidly contracted and structurally shortened, and has become dragged outwardly away from its normal situation above and parallel to the metatarso-phalangeal articulation, the section of this tendon may afford relief.

Another common troublesome defect in the toes, similarly produced, though sometimes hereditary, is fixed flexion of the second toe, the 'hammer toe.' In children under the age of eight or ten years, this defect can usually be remedied by light gentle bandaging (not tight) of the part, upon a padded whalebone splint, night and day, for a few weeks. In older subjects, and in peculiarly rigid cases, section of the flexor tendon, opposite the first phalanx, followed by bandaging on the splint, is a prompt and certain means of cure. It is true that the interphalangeal joints remain straight and immovable. This is in the toes an advantage, as it prevents the possibility of return of the distortion, and it does not interfere with walking.

The little toe is often extended upon the metatarsus, or thrust laterally and inwardly and sufficiently prominent to become continually a source of pain and irritation from the shoe. This also is often a congenital affection. Division of the extensor tendon and bandaging usually afford relief. When the shape of the articular surfaces of the toe and corresponding metatarsal bone are much altered, removal of the toe will alone afford permanent relief.

The toes, and particularly the great toe, are often contracted in cases of varus, congenital and acquired. These contractions are relieved by the means taken to cure the talipes, and sometimes by gradually improving their position with suitable bandages. In other instances, in adolescents and adults, owing to the pain and lameness induced by corns on the prominent parts of the toes, the joints of which had become firmly contracted, the first phalanges in the *extended* position, the terminal phalanges in the *flexed* position, we have found it necessary for entire relief to sever the whole of the flexor and extensor tendons, followed, after healing of the puncture, by bandaging the toes on straight splints for a few days. These cases have shown no disposition to return. We may mention that we have more than once been called upon to do this wholesale toe tenotomy upon three generations, during their respective stages of adolescence. We have never been able satisfactorily to make out to what extent, if any, the contraction was due in each generation to the wearing of unduly small and short boots and shoes. We believe that such cases are due to hereditary predisposition analogous to certain finger contractions (p. 253), hastened on and intensified by the toes being deprived of their natural play and mobility in the cramped space allotted to them.

Forcible extension.—Under the head of *manipulations* and stretchings, the value of *gentle* employment of pressure and movements with the hands (passive exercise), both as a means of curing slight deformities, and as an important auxiliary to other methods of treatment, has been shown. If a larger measure of pressure or force be used with the hands, the treatment becomes that denominated *violent extension.* Here, as elsewhere, it is difficult to draw an arbitrary line, and say where gentle manipulation ends, and violent extension begins. In the practice of manipulations, the competent operator may frequently avail himself of the smaller degree of sensitiveness displayed by some patients, or of the momentary abstraction of the patient's volition from the muscles (a circumstance instantly felt by the hand of the operator), and apply an amount of force which approximates to, or may be considered as, violent extension. But *violent* extension with the hands is rarely efficacious in the removal of considerable contraction and deformity, especially in full-grown persons, because either the pain produced is intolerable, or the voluntary resistance offered by the muscles of the patient exceeds that at the command of the operator; a struggle is maintained between the patient's muscles and the surgeon or rubber, in which the latter is commonly not victorious.

Through the inability of one person to effect, with any effort of his will, an extension forcible enough to overcome severe contraction, violent *sudden* extension,

by means of the combined strength of several assistants, or by means of powerful screws, brought suddenly into action, was proposed and carried out, with varying success and misfortune, by Louvrier, Dieffenbach, Delore, and others. In the less severe cases of deformity, those indeed which are curable by gentler means, without longer duration of treatment, the parts were *suddenly* straightened by violent extension, without ultimately mischievous results, and the expected benefit was obtained. But in severer cases of deformity of many years' existence, in which organic changes of greater magnitude had taken place, as in severe knee-anchylosis from extensive suppuration about the articulation, with necrosis, the violent separation of adhesions, and snapping asunder of bony deposits in the popliteal space and elsewhere, were accompanied with laceration of blood-vessels and nerves, fractures of the bones themselves, and consequent inflammation, suppuration, and even mortification, of the member.

We are indebted to Langenbeck [1] for the aid to, and lessened danger of, forcible extension, afforded by anæsthesia. During anæsthesia the two great obstacles to the employment of force adequate to straighten or bend a contracted limb, namely, pain and voluntary muscular resistance, are removed. As soon as these impediments disappear, the hand of the single operator, and his single mind, applied to the parts, encounter the physical resistance only of the deformed parts; comparatively gentle manipulations now acquaint him with the nature and amount of difficulty; he can feel his way in the application of greater force; can feel and perceive the resistance of parts successfully overcome, in an anatomical order; if greater rigidity still oppose, a few movements of the joint backwards and forwards prepare the way for a more extensive yielding; and often the practitioner has the satisfaction of being able thus to effect every natural movement of the joint. The possession by the surgeon of this prerogative, the handling of a limb under anæsthesia, needs reflection and great caution against abuse of power.

Chloroformisation, with manipulations, and the use of a certain degree of force, may be of service as a means of diagnosis. By it the practitioner is enabled, in some degree, to ascertain what proportion of the deformity is due to shortening of soft parts, how much mischief the articular surfaces have undergone, and what amount of restoration is practicable.

After straightening or bending of the limb, as the case may have required, by means of this forcible procedure, the part should be lightly secured in a retentive instrument or upon a common splint, and adjusted so as to maintain a position more favourable than that in which the limb was before the operation, though it may not always be possible to keep it in the new position, *i.e.* the entirely straight or bent position into which the hands of the surgeon may have brought it. For as soon as the effect of the chloroform disappears, the patient arouses to the conviction of the violence which may have been employed; the part may be acutely painful, and incapable of sustaining the pressure of a tight bandage or ligature.

We usually content ourselves with the increased knowledge obtained of the nature of the case, with the satisfaction of knowing that the part can be improved in form and function, and as the resisting parts have once yielded, that they will afterwards oppose less resistance to replacement; whether the means subsequently employed should be simple manipulations, the use of mechanical apparatus, or the once or twice only repeated administrations of chloroform, and less forcible extension. The surgeon who attempts the forcible binding down of *a long deformed* limb immediately after forcible extension betrays a lamentable indifference to the patient's sensations, and an equal ignorance of the pathological condition of the parts in the immediate vicinity and within the diseased articulation. Although the muscular structures may have yielded under chloroform, and indurated fasciæ and old adhesions may have been overcome by stretching and tearing, it should be remembered that much adaptation on the part of nerves, blood-vessels, and absorbents to the altered

[1] *Commentatio de Contractura et Ankylosi Genu, nova methodo violentiæ extensionis ope sanandis.* Berolini, 1850.

position of the structures needs to be accomplished. We find that, by taking moderate means of retaining as much improvement after the forcible extension as can be borne by the sufferer, by the unsparing use of lotions of spirit or by ice applications, and by the internal or endermic use of morphia, inflammation of joints thus straightened has been averted.

It is perhaps not superfluous to remark, that the use of forcible extension is less defensible in cases of recent disease of articulations than even other active attempts to restore the form in such cases. In a diseased joint the practitioner has to note not only the local disorder, but also the general condition, of which the local affection is but one manifestation. When the surgeon, with ability and experience, has cured the local disorder, *i.e.* removed the inflammation, healed the ulcerated or suppurating parts, or effected subsidence of pain, heat, and tumefaction, the consequences of the diseased action, contracture and rigidity only remaining, he has not necessarily cured, by internal and therapeutic measures, the morbid constitutional state. This often slumbers after subsidence of the local disease; and he should pause ere he too hastily undertakes the restoration of form and movements by forcible extension under chloroform, or by other active measures, and thus incautiously evoke a renewal of local disorder.

These views were enunciated[1] some years ago by the author, perhaps with more leaning to the employment of forcible extension. It will be found that violent extension is necessary in a relatively small number of cases provided gentler means are suitably carried out. Orthopædy is capable of curing all those contractions in which the innervation is not hopelessly disturbed (severe paralysis and spasm), and those in which the synovial surfaces, cartilages, and articular extremities of the bones are not disorganised from disease. When we cannot hope to do more than straighten the limb, as in long-standing hip and knee contractions from articular diseases, rational violent extension under ætherisation is most opportune as a means of obtaining a more useful position of the member.

The expectations of surgeons some years ago of the benefit likely to result from operative interference in cases of partial hip anchylosis, so as to produce a new or artificial joint, have not been verified. Excision of the head of the femur, owing to inability to deal effectually with the co-existent disease of the acetabulum, has been less successful than elsewhere. In long-standing hip anchylosis, be it false or true, if we should be unable to straighten the member by gradual mechanical treatment, or by forcible manipulation under chloroform, there is one resource available, that of severing the bone subcutaneously below the trochanter, where it most nearly approaches the surface; or as recommended by us in the last edition of this work; or as carried out by W. Adams, above the trochanter. The late Mr. Maunder, following the example of Mr. L. S. Little, had excellent results at the hip from division of the femur with the chisel and mallet (see the description of the various operations of osteotomy appended to the section on Rickets in the essay on Diseases of Childhood, vol. iii.)

In a few cases at the other extremity of the pathological scale, in which the will alone, or timidity, or the peculiar abnormal state of the system exists which is met with occasionally in young persons of both sexes, in whom, in consequence of slight injury, a limb remains stiff in the straight or bent position (emotional or ideal paralysis), the part is relaxed under ætherisation, and the contracture is often by this means promptly and permanently cured. True hysterical contractures yield with equal facility during the anæsthetic state; but they usually return when the effect of the chloroform has passed off. In some of the severest hysterical cases the author has met with, recovery has taken place after the lapse of a few months, or a year or two, either spontaneously, or from the effect of altered dietetic, social, or climatic influences (p. 259).

The following case well illustrates the diagnostic and curative value of judicious investigation under anæsthesia :—

[1] *Treatise on Deformities of the Human Frame.* 1853.

December, 1854. Master C ——, aged 12, an intelligent lad, was brought on account of stiff straight knee. Six weeks previously he fell whilst running, and was supposed to have wrenched or struck his knee against a projecting ledge of stone. After the accident he hobbled half a mile, and continued very lame, the knee immovably stiff. On examination we found neither inflammation nor distortion, or other cause of stiffness. The force of 'position fixe' was so considerable that we could make no impression upon it with our unassisted hands. He did not appear unduly nervous, and as it was holiday time it was unlikely that he had any inducement to malinger. We suspected dislocation of articular cartilage. Exploration under anæsthesia was undertaken. During inhalation the leg projected stiff over the side of the couch. Gradually, as the anæsthetic took effect, the weight of the foot and leg caused bending of the knee. No further treatment was needed; the knee continued flexible and fit for immediate use.

W. J. Little, 1882.

DISEASES OF THE BONES.

DISEASES of the bones may be conveniently divided into the following classes:—*First*, inflammation and its consequences: under which head it is proposed to include the varieties of the inflammatory process, which have received the names of periostitis, ostitis, and osteo-myelitis; and, as consequences of these, all the numerous conditions which have been confounded together under the common but vague designation of caries, the various forms of suppuration in bone, the varieties of necrosis, its effects, and those processes of repair which result in permanent modification of the structure and form of the organ. The *second* class will include the specific diseases, which occur either as modifications of the inflammatory process—syphilis, scrofula, and rheumatism in bone—or as constitutional conditions leading to changes in the bony structure; such are mollities ossium, rickets,[1] and cancer. The *third* division will comprise a description of the various new formations found in the osseous system, and which are not dependent on any of the known constitutional cachexiæ. The *fourth* will treat of atrophy and hypertrophy, properly so called, *i.e.* uncomplicated by inflammation.

Simple Inflammation and its Consequences.

Inflammation of bone differs from inflammation of soft parts, not in its essential, but in its accidental features; the inflammatory process is the same, but the conditions or circumstances are different, and hence arise diversities in rate of progress, in external appearance, and in other symptoms; diversities which, although they are not really essential, yet cause striking differences to ordinary observation, and have led to the designation of the results of inflammation in bone by names differing from those which are used for the same changes in soft parts. This difference in nomenclature, though it might arise in mistake, at a time when necrosis was thought to be something essentially different from gangrene, and caries a disease which had little in common with ulceration, is yet hardly to be regretted, since the diseases of bone, though pathologically identical, are practically very different from those of soft parts; and it is convenient to have separate names for things which require very different treatment, and entail a very different amount of danger.

If the reader will consult the essay on Inflammation, he will find abundant information on the early steps of that process. These affections are identical in bone and in soft parts; in fact, they can occur only in the soft parts of bones, since the mere inorganic matter, which, involved in the convolutions of a cellulo-fibrous and vascular network, constitutes a bone, can itself be the seat of no vital actions, but must obey the movements impressed upon it by the living textures around.

The essential elements of the inflammatory process in bone appear to be the proliferation of the soft structures, accompanied by the multiplication and enlargement of the cells which those structures contain, and by an increase in the quantity (possibly also by a change in the quality) of the fluid by which the organic elements of the bone are permeated and nourished. This increased growth of the soft structures causes them to press upon and eat into the inorganic skeleton, and it is the opinion of some pathologists (as Rindfleisch) that the inflammatory fluid acts as a direct solvent on the salts of the bone. Hence, on microscopical examination, there

[1] The subject of Rickets, however, will not be found here, as it has been thought better to refer it to the Surgery of Childhood.

will be found, between the trabeculæ of the bone, a fungous mass somewhat analogous to granulations, and often called by that name, in which may be distinguished the altered cells of the part, frequently in the form of those giant-cells which Kölliker called 'osteoclasts,' when occurring in the growing bone, from their supposed function of destroying or absorbing the old bone. The projection of these granulations against the trabeculæ hollows the latter out into irregular spaces, called 'Howship's lacunæ,' just as in the normal growth of a young bone the central space is enlarged by absorption around the growing medulla. The medullary tissue of the inflamed bone is also swollen, granulating, and often permeated with pus. The lacunæ break down, and often break into each other, so as to present the appearance of a canal, a phenomenon described by Rindfleisch as the 'canalization' of bone. All this leaves the bone, of course, much more fragile, light, and juicy, than natural. To this early stage succeeds one in which the presence of suppuration is more decided, and the erosion of the internal spaces of the bone more advanced—and now the bone is said to be carious. All this refers to the inflammatory process when most acute, and therefore most easily perceptible. There is no reason to think that chronic inflammation differs in its essential features; but it is hardly possible to find a bone in the early stage of chronic inflammation.

Such are the earliest changes in the minute structure and consistence of inflamed bone. The changes which take place in its rough anatomy may be thus described. If a bone be examined at an early period of inflammation (the ordinary and most accessible instance is the stump of the bone in an amputation fatal, say, three weeks after the operation),[1] the periosteum will be found somewhat thickened, vascular, and not so closely connected to the bone as usual.[2] If the periosteum be stripped off, the bone is seen to be irregularly vascular, some portions of it having a slightly red tint, and contrasting with the healthy white colour of the rest of the bone. This red tint is evidently caused by the enlargement of the vessels which pass from the periosteum into the bone; and if a magnifying-glass be used, the increased size of the vascular apertures is easily proved, while if pressure be made on the surface of the bone, drops of blood will frequently ooze from the mouths of the enlarged vessels, proving their increase in size, as well as the loss of consistence in the outer hard wall of the bone. At the same time there will be found, in all probability, on some other part of the surface, more or less deposit of osseous matter, which, with the partial separation of the periosteum above mentioned, testifies to the fact of effusion from the vessels of that membrane. In these simple cases of injury the deeper parts of the bone will probably be unaffected; but should this not be the case, *i.e.* should inflammation have also attacked the membrane lining the medullary cavity and cancelli, that membrane will be found in a condition essentially analogous to that of the periosteum, although the different situation of the medullary membrane, and the great quantity of fat and other loose tissues among which its vessels run, will somewhat modify the external appearances. If, however, these appearances be minutely investigated, they will be reduced to, increase in the number and size of the vessels, and effusion of blood, lymph, or pus, according to circumstances. The thickening both of the periosteum and of the medullary membrane is sometimes considerable. The former membrane is, of course, more frequently found thickened than the latter; but preparations showing the participation of the medullary membrane in inflammation of the bone, and the identity of its appearance with that of the thickened periosteum, are not wanting.[3]

Thus we see that when inflammation commences, as it usually does, on the surface of a bone, whether periosteal or endosteal, its primary symptom is increase in

[1] In such a specimen the periosteum will generally be sound stripped off from a small ring at the lower end of the bone, and this part will perhaps be dead or about to die; but as this feature is accidental, it will not be further noticed.

[2] Hunter has put up (Mus. Coll. of Surg. No. 656) 'A preparation of a femur, which was amputated, with the periosteum separated; to show how clear the periosteum separates from the bones in inflammation; a fact almost always observable after amputation.'

[3] One of the most striking preparations of this kind is in the Museum of St. Bartholomew's Hospital—a humerus; series i. 207.

the size (and perhaps number) of the capillary vessels, or vascular spaces, and effusion of blood or lymph. The primary effects of inflammation in the central parts of the compact tissue are similar to the above; though here, from the different circumstances in which the vessels are placed, this similarity has been less distinctly perceived; and from the slowness with which all changes go on in the compact tissue, opportunities rarely occur of comparing the different parts of the same bone with each other. The first change is the enlargement of the vessels which run in the Haversian canals; but effusion is a much later phenomenon, and is preceded by the absorption of the bony tissue which adjoins the enlarged vessels; so that in microscopical sections of inflamed bone, the Haversian spaces are seen much enlarged, irregular, eroded, and sometimes almost, or quite, communicating with each other. The lacunæ may also be noticed to be densely crowded together, and sometimes the granular matrix of the bone appears more coarse than natural. When this absorption of the walls of the Haversian canals becomes visible to the naked eye, the first change in the rough anatomy of inflamed compact tissue becomes appreciable—that in which spaces are seen in it on section like those in cancellous tissue, so that it is sometimes said to become cancellous. Similar changes occur in the cancellous tissue itself, whereby its cells become much enlarged, and sometimes the whole bone is expanded by the simultaneous yielding of its walls.[1]

Into the spaces thus hollowed out in the substance of the bone, or on its surface, by the removal of the earthy matter, the products of inflammation are next secreted. These secretions vary, of course, according to numerous preceding circumstances, *e.g.* the nature of the injury, or other cause of inflammation, the activity of the process, the constitutional condition of the patient, and a thousand others; and so the products of ostitis are divisible into two principal varieties, corresponding to the plastic and aplastic lymph met with in other parts, and leading, the former to the deposition of earthy matter and the formation of new bone, and the latter to suppuration. The former result terminates in hardening, or *sclerosis*, as it is termed; the latter in a variety of conditions: when the suppuration is limited within a cavity in the cancellous tissue, or in the compact tissue rarefied by previous inflammation, *circumscribed abscess* is produced; when the pus extends along the inner surface of the membrane lining the medullary cavity and cancelli, the condition of bone exists which is now usually spoken of as '*osteo-myelitis*,' and which used to be called 'diffused suppuration in bone;' suppuration between the periosteum and bone forms *periosteal abscess*, acute or chronic; and any of these forms of suppuration, when accompanied by the insensible exfoliation of the bone (or its death, and removal in invisible portions), constitutes ulceration of the bone, or *caries*. Lastly, inflammation of the bone sometimes leads to the death of larger portions of its tissue, which are then removed by the process of ulceration, as in soft parts. This constitutes gangrene of bone, or *necrosis*; but as that condition, like other forms of gangrene, is often produced by other causes not inflammatory, the whole subject of necrosis must be treated by itself.

We have now to consider separately the causes, symptoms, and treatment of each of these phases of the inflammatory process; the above being intended only as a kind of ground plan, to mark out the various parts of a rather intricate subject, each of which must be studied in detail.

Ostitis.—Inflammation of bone is excited usually by external violence, or exposure to cold, acting upon a constitution predisposed to the disease. The chief predisposing causes are, the syphilitic or scrofulous taint, rheumatism, and defective nutrition; or these may themselves set up inflammation in any bone, without a distinct exciting cause. From this mode of causation it follows that the bones most liable to inflammation are those most exposed to the action of external agents.

[1] See a description, by the author, of the bones of the lower extremity ten months after excision of the knee, where the superficial laminæ of the femur had been so separated from each other by inflammation that the bone crackled under the pressure of the finger (*Path. Soc. Trans.* vol. xii. p. 171).

Hence we see it most frequently in the tibia among the long bones, and in the skull, sternum and ribs among the flat bones. The bones of the foot and hand are also very frequently affected.

Ostitis is a very common affection, although not much recognised; partly because, from the little attention it has received from our older authors, and from the fact that most swellings of bones are regarded as periosteal, we are not much in the habit of looking for it; and partly because its symptoms are at first obscure, and liable to be masked by those of the injury to the soft parts with which it is associated, or of the constitutional affection from which it springs.

The symptoms vary according to the stage of the inflammation. In the first stage, that in which the size of the vessels is increased, and in which absorption is being produced, the disease frequently makes considerable progress without appreciable symptoms.[1] Sooner or later, however, the occurrence of those characteristic dull pains in the bones, exacerbated by changes of weather, increasing in severity during the night, and somewhat resembling the pains of rheumatism, which are described by French writers as 'douleurs ostéocopes,' draw the attention of the patient to the seat of the disease, and form a valuable guide to the surgeon. If the part be now examined, the probability is that some evidence will be found of inflammation in the tissues surrounding the bone—œdema, redness of the skin, tenderness of the soft parts, or threatening abscess.[2] The absorption of the earthy material, which accompanies this increased vascularity, manifests its effects upon the bone by a diminution in its consistence, and then the bone becomes at the same time increased in volume and diminished in its resistance to pressure. The former symptom is indeed somewhat delusive, since the apparent increase is often due principally to enlargement of the soft parts. But the swelling of the bone may sometimes be made out very clearly, and is then a valuable indication of the disease. The softening is not generally of much importance as a diagnostic symptom; it rarely affects the whole thickness of a bone, so as to lead to a change in its form, and, when limited to a portion of the surface, cannot be appreciated by the touch, since the inflamed and irritable condition of the soft parts renders the patient unable to bear the necessary pressure.

A singular change, which sometimes follows inflammation of a long bone, is its elongation. Dr. Humphry has laid much stress upon the consequences of diseased conditions of the epiphysial lines near the ends of long bones, as affecting their subsequent growth.[3] It is possible that inflammation of this tissue may have led to the elongation of the bone in some of the cases; as in a tibia from a lad aged eighteen, preserved in the Museum of St. Bartholomew's Hospital, in which the bone has become lengthened, and is curved in order to adapt its length to that of the healthy fibula.

To the stage of absorption and rarefaction succeeds that of effusion and deposit, unless the process be arrested, and resolution occur. The various consequences of suppuration enumerated on the previous page being reserved for subsequent sections, we need now only consider that termination of inflammation of bone in hardening or sclerosis, which corresponds to the inflammatory solidification of parenchymatous organs; and which, when not too extensive, is for practical purposes little less desirable than complete restoration to health. The interstices of the cancellous tissue are filled up at first with lymph, in which ossific matter is afterwards deposited; and then the bone, which, while actively inflamed, had been less dense than in its healthy condition, as

[1] This is true more especially of the earlier stages, but is occasionally observed in all periods of inflammation of bone. Thus large psoas abscesses, connected with extensive erosion of the vertebræ, are found sometimes in patients not of a strumous habit, and who have not been known to present any symptoms of such an affection.

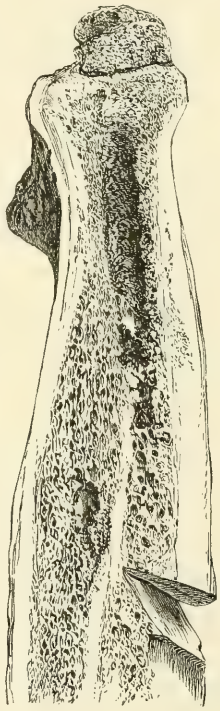
[2] It has been asserted by Lücke that the tenderness of the bone to percussion may be made use of as a diagnostic sign of the presence of inflammation, and for this purpose he uses a percussion-hammer formed of a whalebone handle with a metal head coated with india-rubber. By comparing the effect of similar blows with the hammer on the bones of the two sides, the fact of increased sensitiveness, and therefore of inflammation in the suspected bone, is to be verified, whilst its exact seat will be fixed by observing the direction and the force of the shocks necessary to elicit the morbid sensation (Lücke, *Archiv. f. Klin. Chir.* vol. xxi.)

[3] *Med.-Chir. Trans.* vol. xlv. p. 294.

in fig. 43, becomes hard, heavy, and solid, as in fig. 44; the medullary canal is narrowed or filled up, and the shaft thickened by deposit from the periosteum. Bones thus affected abound in every pathological collection; and it is easy to trace in them many of the appearances of which an explanation has been attempted above —the large size of the vascular apertures, the irregular deposit of bone, both in the centre, in the substance, and on the surface of the shaft, the contraction of the medullary cavity, and usually the increase in size of the nutrient foramina. It will generally, but not always, be noticed that these changes are limited to the shaft of the bone, when it is the part first affected, and that the articular ends escape. The converse is also usually the case; though perhaps the shaft is more prone to become

Fig. 43.—(From a preparation in the Museum of the Royal College of Surgeons, No. 3085, to illustrate the rarefying stage of ostitis.) The tibia in this case weighed 9 ounces.

Fig. 44.—(From a preparation in the Museum of St. George's Hospital, series ii. 19, to illustrate the termination of ostitis in condensation or sclerosis.) The tibia in this case weighed 19 ounces.



involved in the morbid actions of the joint-ends than the joint-ends are in those of the shaft. Thus inflammatory affections may long go on in the shaft of the femur, yet the knee-joint remain unaffected; and, on the other hand, when disease of the joint commences in the articular ends of the bones, the shafts usually are unaffected, and the disease of the bones considered by itself is not so extensive as to contra-indicate excision. To each of these two general rules, however, numerous exceptions will, unfortunately, be met with in practice.

Inflammation of the bone is almost always known, in common parlance (when it is recognised at all), as *periostitis*; but, in truth, periostitis seldom occurs uncomplicated, unless in the course of secondary syphilis;[1] and almost all the cases which pass under that name are really inflammations, more or less extensive, of the bone. Periostitis is a quicker process, and one more under the influence of remedies than

[1] I would refer the reader to the section of Syphilis in Bone for further details on the subject of chronic periostitis.

the other forms of inflammation of bone; but in all the same general course of treatment is indicated, viz. the internal administration of iodide of potassium, and the local application either of iodine or mercurial ointment, or, in the early stage of the disease, of blisters. These measures should be combined with proper position of the affected member, and as much rest as is consistent with attention to the general health. Leeches or cupping will afford relief if the pain be severe. When there is much tension over the bone, sometimes accompanied (especially in the cranium) with intolerable pain, nothing gives such immediate and decided relief as a free and bold incision down to the bone. The distended periosteum is thus relaxed; and in cases of pure periostitis such a measure may of itself almost suffice for the cure of the disease; but its beneficial effects will be decided, though less striking, in cases of

Two drawings from a preparation in St. George's Hospital Museum, to illustrate the ordinary anatomy of periostitis.

Fig. 45.—Periostitis. (Internal view.) Fig. 46.—Periostitis. (External view.)

deeper-seated inflammation. In cases of chronic inflammation of bone, accompanied by deep-seated and wearing pain, an opening made with a trephine, for the evacuation of pus, has proved beneficial, even though no pus was found.[1]

Whether the sclerosis, or induration, which is the final result of chronic inflammation, be amenable to any remedial measures is doubtful, since it usually gives the patient little inconvenience, and therefore is not made the subject of treatment. Thickening over the bone is often left after ostitis, and is often dispersed by the ordinary measures, such as friction and pressure; but the seat of this thickening is very generally in the soft parts around the bone, and not beneath the periosteum.

Ostitis deformans.—A very curious condition, obviously the result of chronic inflammation, has been described by Sir J. Paget[2] under the name of 'ostitis

[1] See a case reported by Sir B. Brodie, in his *Lectures on Pathology and Surgery*, p. 410. On the good effects of a free incision of inflamed periosteum, when milder measures fail, see Sir P. Crampton 'On Periostitis,' *Dublin Hospital Reports*, vol. i. p. 331.

[2] *Med. Chir. Trans.* vol. lx.

deformans.' Five cases are given which occurred under his own observation, and a few references to others more or less similar recorded by other authors. The disease occurs without known cause, but resembles chronic rheumatism in the pain which accompanies it. It is marked by a gradual enlargement of the bones affected; so that the head increases gradually in circumference, or the limbs in length, and at the same time the bones yield to pressure, causing curvature of the legs or arms, shortening and fixation of the spine, and change of shape of the thorax or pelvis. It does not seem that the disease in itself shortens life,[1] or that it is necessarily associated with any constitutional cachexia. Three out of Sir J. Paget's five patients died of cancer; but, as far as appears, this was only an accident. No treatment has hitherto had any effect. Sir J. Paget's paper contains illustrations both of the general features of the disease and of the rough and microscopic anatomy of the bones involved.

I ought here also to mention the curious cases which have been recorded by Virchow under the name of Leontiasis ossea, and which will be found referred to in Sir J. Paget's paper—a disease commencing in early life, and affecting the cranial and facial bones, causing a great increase in their bulk, so that they become 'hugely thickened, porous, or reticulate:' the cavity of the skull and the various cavities of the face are gradually encroached on by the enlarging bones, and so death is slowly produced. In connection with these may also be noticed the singular instance of periosteal formations on the skull, facial bones, hyoid bone, and fibula, recorded by Mr. De Morgan for Mr. Bickersteth, 'Pathological Transactions,' vol. xvii. Mr. Bickersteth's patient died of exhaustion, apparently the result of encroachment on the cavities of the face. In none of these cases has any explanation been given of the origin of the disease, nor do they seem to be connected with syphilis or any other cachexia. Stromeyer alludes [2] to a case of gout in which nearly all the bones of one side of the body were hypertrophied; but no opportunity for post-mortem examination occurred.

Diffuse periostitis.—Inflammation of the bony tissue itself is rarely acute, and when it does occur in the acute form passes rapidly into necrosis, under which head it will be presently spoken of; but acute inflammation between the bone and periosteum, *diffuse periostitis*, is a disease of rather frequent occurrence. It is seen commonly enough in persons about the age of puberty; more frequently in boys than in girls; usually as the result of some injury, and almost always in one of the long bones. It is so destructive in its effects, so rapid in its course, and is so often overlooked or mistaken at first, that we have unfortunately numerous opportunities of verifying its existence after the time for treatment has passed away; yet to early and vigorous treatment it is tolerably amenable, at least as amenable as so acute a disease can be expected to be.

The pathology of the disease appears to consist in the partial separation of the periosteum from the bone, by effusion on the surface of the latter of lymph, or other products,[3] soon giving place to a copious formation of pus, which spreads along the whole bone, and dissects away the periosteum from it, often from one end of the

[1] In one of the cases the movements of the thorax were so obstructed that the patient died of asphyxia.

[2] *Handb. d. Chir.* i. 442.

[3] The disease does not commence by the formation of abscess: often when the swelling and inflammation are considerable, no pus will be found. Of this fact the following is an instance. A lad was suffering from what was supposed to be diffuse cellular inflammation around the ankle after a slight injury. As it was suspected that the inflammation was really subperiosteal, an incision was made down to the tibia. No pus followed. Two days afterwards the boy presented obvious symptoms of confined matter, and now by breaking up the adhesions of the wound a copious evacuation of pus was obtained, and the surface of the bone was felt exposed. A few days later, swelling and tenderness were found over a higher part of the tibia. Thinking that on the former occasion I might not have divided the periosteum freely enough, I now took care to press the edge of the knife firmly against the bone for some distance. Matters went on exactly as in the former wound. No pus was found at the time, but on breaking down adhesions, two days later, with a probe, the pus was discharged, and the bone was felt exposed.

bone to the other. If examined at an early period of the disease, the periosteum does not (at least it very often does not) display any distinct signs of inflammation, either in change of colour or of thickness; nor is the surface of the bone visibly inflamed. On the contrary, it usually looks white, and inclined to gangrene, a consummation which rapidly impends over such cases. Sometimes, however, the surface of the bone may be found slightly worm-eaten, and, on squeezing it, its superficial layers are found more readily separable from the deeper tissue than in health; large drops of blood can in such instances be pressed out of the vessels which pass into the bone from the periosteum. A little later, and necrosis is unmistakably declared, and the whole diaphysis usually perishes, leaving the articular ends unaffected, and therefore not involving the neighbouring joint.

The joint, however, does not always escape. A girl aged fifteen was admitted into hospital four days after an injury, with great swelling of the forearm, evidently depending on the formation of matter. A grating sensation, perceived on rotating the hand, together with the history of the accident, led to the belief that fracture had occurred. She died of pyæmia; and then it was discovered that a periosteal abscess, extending from the shaft of the radius into the wrist-joint, had so eroded the articular cartilages as to occasion the sensation of crepitus.

The course of the disease is usually as follows: it commences in the great majority of cases with an injury of more or less severity, occurring to a person generally of the strumous constitution, at any rate a weakly person; the symptoms which immediately follow the injury are usually slight, so that even the occurrence of the accident is perhaps nearly forgotten; then, after a varying lapse of time, probably four or five days, symptoms occur which are almost invariably attributed at first to diffuse cellular inflammation, or to acute rheumatism, viz. rigors, pain in the part, and an œdematous angry swelling. At the outset the diagnosis is not easy; indeed, before suppuration has occurred, perhaps no certain diagnosis can be made. However, as respects diffuse cellular inflammation, the age of the patient, the comparative remoteness of the cause, and the previous immunity of the superficial parts, will lead to a suspicion of the nature of the case, which will be strengthened when the inflammation is seen to be limited to the section of the member first affected, instead of passing the joint, and spreading up the limb, as an erysipelatous affection would in all likelihood do, and will be converted into certainty by the discovery of deep-seated matter, either by fluctuation or on puncture. Fluctuation cannot always be detected, since the tension of the membranes which bind down the pus, and the tenderness of the superficial parts, combine to oppose its discovery. Exploratory punctures, however, should never be neglected. If the disease be merely superficial, they can do no harm; and it is of vital importance to discover early, and give instant exit to, the pus before it has dissected off large portions of the periosteum, and involved the death of a great part of the bone. The diagnosis between a case of this sort and one of acute rheumatism will depend upon the nature and history of the disease, and on the presence or absence of constitutional symptoms of rheumatism, or rheumatic affections of remote parts. At the outset of the case the diagnosis may not be very confident; but the main point to recollect is, that any periosteal affection, if acute, is liable to run early into suppuration, and that in such cases, whatever view may be taken of the origin of the disease, whether it is to be considered rheumatic or otherwise, the local treatment is far more important than the constitutional. What Sir P. Crampton says of the acute periosteal whitlow applies with much greater force to acute periosteal affections of the larger bones: 'There are few diseases where art can do so much and nature so little.'

If the disease be allowed to go on unchecked, the whole circumference of the limb will become greatly swollen and œdematous, usually with that tense glistening aspect which tells of subjacent suppuration. The patient mostly complains of great pain, especially acute at night; he loses appetite and flesh rapidly. Pyæmia is very liable to occur, and many of these patients die of it. A few die exhausted by the violence of the action, and by the profuse suppuration. If the patient survive, and the abscess do not obtain a free and depending opening by timely incisions, it will

burrow among the muscles, and ultimately numerous openings will form, exposing necrosed bone. The dead bone appears to separate much sooner than in other forms of necrosis, and the repair to be proportionately active. Thus, in an adult, almost the entire length of the shaft of the ulna was thrown off and removed three months after the injury which led to the complaint; and, even at that date, the repair appeared to be far advanced. In less acute cases, where only a portion of the surface of a bone is involved, the disease pursues the ordinary course of necrosis.

The subjects of this affection are almost always young persons,[1] in whom the strumous diathesis is well pronounced; but it occurs more rarely in healthy subjects about the age of puberty, or even earlier; and some cases are observed (as the one to which allusion has just been made) in adults of impaired constitution and dissipated habits.

The bone affected is, in the great majority of cases, the femur or tibia; and it is no doubt in consequence of the great size of these bones, and the severe effects which always attend upon a large abscess situated below the fascia, that the disease is so fatal. But reference has already been made to two cases in which the bones of the forearm were attacked; and any of the long bones may be the seat of the disease, and not unfrequently is so. The flat and irregular bones are more rarely affected; but Sir P. Crampton's case [2] is well known, in which an acute abscess formed beneath the periosteum of the bones of the nose and cranium on both sides. A well-marked instance of acute periosteal abscess of the sternum is described in the 'Path. Soc. Trans.' vol. xv. p. 181, and another less clearly described, but probably of the same nature, in vol. iv. p. 61 of the same series.

The treatment of acute periosteal abscess is a matter of the gravest importance, as it is only by vigorous measures that so rapid and dangerous an affection can be relieved. Among these measures, the first and most important is to make timely and sufficient incisions into the swelling. If doubt exists as to the nature of the swelling, or as to the situation of the pus, they will be settled by the grooved needle; but even if no pus be found, it is better in any case of acute periosteal inflammation, where the pain is great, to make an incision down to the bone in the part to which such pain is referred. In children, it will be advisable to administer an anæsthetic before commencing the examination when the affection is deep-seated.

Periostitis sometimes occurs in a sub-acute form, marked by rapid swelling around the bone, and by a certain amount of aching pain, but without the severe constitutional symptoms which accompany the graver disease. Incisions should not be made in these cases, unless the surgeon is sure that matter has already formed. The free application of leeches and local warmth will often obviate suppuration; and many surgeons have much confidence in iodide of potassium in full doses, as a remedy in this sub-acute form of the disease.

During the acute stage of a periosteal abscess, free exit having been obtained for the matter, the patient must be treated on general principles; no special internal treatment is necessary for the affection of the bone. The indications are, to allay pain, to support the strength, and to avoid, if possible, the constitutional affection which leads to pyæmia. The last is the most important of all; patients seldom die of the 'surgical fever,' so called, which is usually present; they seldom die of the exhaustion of the discharge; but they die by pyæmia in a large percentage of the cases. Free and early incisions give the patient the best chance of escaping this fatal complication. No fear need be entertained of decomposition of the pus from the admission of air. In fact, pus which is confined over a bone in an acute inflammatory disease, will probably be already sufficiently putrid. After the opening, the

[1] Chassaignac says, that out of eleven cases, only one had passed the seventeenth year, and was below twenty-one; and one was only eleven months old. In the *Path. Soc. Trans.* vol. vi. p. 284, a well-marked instance is recorded at the age of eleven days. A circumstance which seems to testify to the effect of a constitutional predisposition is mentioned by Chassaignac, viz. that in some cases several acute periosteal abscesses have been present in the same subject (*Mém. de la Soc. de Chir.* vol. iv. pp. 286–7).

[2] *Dublin Hospital Reports*, loc. cit.

cavity of the abscess should be frequently syringed out with antiseptic solutions. The openings should at first be made in as depending a position as possible, and they should be so free as to preclude all risk of their closing again. Free stimulation is generally, if not always, necessary. The patient will, perhaps, be unable at first to take solid nourishment, since these affections are generally attended with severe fever; but as soon as the evacuation of the matter has removed some part of the irritation, his appetite will probably return.

If the patient has survived the acute stage of the disease, the abscess may long remain in a chronic condition, exposing the bone. In the more favourable cases, the outer shell only of the latter has perished; while in the most severe, the entire shaft, separated from the epiphyses, may come away in a mass; or even the epiphyses themselves may share in the destruction, though that is not often the case. The treatment of these sequelæ of diffuse periostitis will be spoken of in the section on Necrosis, where also will be found discussed the subject of sub-periosteal resection for acute disease.

Epiphysitis.—A very interesting and formidable variety of acute inflammation is that which affects the epiphyses in early life. This is closely connected with acute periostitis, and with osteo-myelitis; but as it leads to degeneration of the joints, it has been thought better to treat it among DISEASES OF THE JOINTS.

Osteo-myelitis.—Diffuse inflammation, and suppuration, in the cancellous tissue, an affection to which French pathologists have given the name of 'osteo-myelitis,' is more frequently recognised in post-mortem examinations than at the bedside of the patient. This affection, when it is most acute and extensive, is closely allied to pyæmia, and is frequently followed by that mode of death. It bears the same relation to the medullary tissue as the complaint just spoken of does to the periosteum; but the difference in character between the periosteum and the medullary tissue, the latter being so much more rich in vessels, especially in large patulous venous channels, gives to osteo-myelitis a gravity even beyond that of diffuse periostitis. It is well known how often diffuse suppuration is found in the diploë of the cranium after scalp-wounds, and how the 'puffy tumour of Pott' is frequently only the sign of such suppuration; and further, in what a large percentage of such cases evident pyæmia is found. It is probable that in all these cases the external table of the bone has been wounded, and the diploë thus exposed; in fact, the only known cause of osteo-myelitis is a wound which exposes the cancellous interior,[1] or an injury to the interior of the bone, perhaps unaccompanied by external wound, as in fracture or severe contusion.[2] It is a frequent cause of death after amputations and other surgical operations in which bone is divided. Lately in Italy attention has been called to the connection which has been observed to exist between inflammation of the medulla of the bones, and the disease of the spleen and other blood-glands, so often resulting from the malarious fevers there prevalent, and the observation is an interesting one, especially in view of the function which physiologists now agree to give to the medulla of the bones in the formation of the blood-corpuscles.[3]

When a bone is examined in which osteo-myelitis has run an acute course, the cancelli are found loaded with pus, and the medullary tissue usually injected and often sprinkled with ecchymoses; the periosteum also is often in the course of separation from the bone; but the bony tissue itself does not necessarily show any appreciable change. When it does the changes are such as are described on p. 276. In the larger bones the disease usually terminates fatally at this stage; but should the patient survive, the pus may penetrate into the neighbouring parts, most probably into the nearest joint, or central necrosis may result.

[1] Unless the infection of constitutional syphilis should be added. See *infra*, on 'Syphilis in Bone.'

[2] Mr. Macnamara has also met with cases of acute osteo-myelitis attributed to exposure to cold.

[3] See Dr. Tassi's pamphlet, *Studj di Anatomia patologica e Clinici sulle Malattie delle Ossa.* Rome, 1877.

Specimens to show either of these terminations are not wanting in our pathological collections. Thus, in the Museum of St. Bartholomew's Hospital there is a beautiful specimen (i. 207) of inflamed and thickened medullary membrane of the humerus, which shows, as a consequence of the inflammation, a portion of cancellous tissue exfoliated and lying loose in the medullary canal. A long fistula leads through the tube of the bone into the elbow-joint. The same Museum possesses another specimen (i. 195), in which acute diffused suppuration, spreading through the tissue of many of the long bones, has caused abscess in the knees and ankles on both sides.

The symptoms of this grave affection are exceedingly obscure: it, like other extensive and acute affections of bones, is often accompanied by diffuse inflammation of the soft parts, which then masks the deeper affection. Rigors and general fever always mark the onset of acute osteo-myelitis, but the only known special symptom of the disease in the bone is the separation or recession of the periosteum from it, accompanying diffused pain in the bone, and not caused by effusion on the external surface of the latter. After amputations, a prominent fungous mass is often seen projecting from the end of the bone, and proves the existence of a certain extent of inflammation of the medullary tissue; but this need not necessarily have affected the bone so extensively as to deserve the name of osteo-myelitis; in fact, that affection is seldom recognised before death.[1]

To obviate the formidable dangers, and the extensive disintegration of parts connected with osteo-myelitis, it is justifiable in any case where pain in the bone, accompanied with the ordinary symptoms of acute suppuration (rigors, fever, &c.), but without signs of external or periosteal mischief, induces a reasonable suspicion of this affection, to expose the surface of the bone by a free incision. Should the periosteum be found separated, or even separating, from the bone, the diagnosis of diffused suppuration in the cancelli will be rendered highly probable. When this separation of the periosteum has proceeded to any great extent, amputation of the member, or excision of the diseased bone, is certainly indicated. It should be remembered that the disease is a rapid one, the fatal complications of internal phlebitis and pyæmia imminent; and therefore treatment, to be effectual, must be adopted early. Medicine, as might be expected, has little effect on the disease; but the fever which accompanies it should, of course, be treated on the ordinary principles. In deciding on the question of removing the diseased bone (an operation which would in ordinary cases be held to be contra-indicated if pyæmia had set in), it should not be forgotten how obscure the early symptoms of systemic affection are, so that it may be proper in doubtful cases to give the patient the benefit of the doubt, and attempt to relieve him from the source of irritation.

How far it is possible, in practice, to separate acute periostitis from acute osteo-myelitis is a question on which surgeons differ widely. Many French and German pathologists seem hardly to admit the existence of the disease which I have described above as diffuse periostitis, apart from osteo-myelitis, of which, indeed, they consider it as merely a complication. Some, without going so far as this, yet say that the whole thickness of the shaft of a bone never perishes unless the medullary tissue is involved. I have, however, seen convincing instances to the contrary; and I am confident that cases of acute periostitis do occur in which the whole thickness of the shaft (and sometimes the entire shaft) perishes, without any implication of the medullary membrane; though I allow that, in most cases of diffuse periostitis implicating the whole thickness of a bone, the medullary tissue is more or less involved.

In chronic osteo-myelitis the removal of the limb is frequently successful in affording the patient relief from an abiding source of irritation, which will at length

[1] If after an amputation acute osteo-myelitis be suspected, the surgeon can establish his diagnosis by putting the patient under chloroform, and ascertaining by means of the probe that the whole medullary tissue is broken up for a considerable distance, as well as the small portion which is projecting out of the wound. See Fayrer, in *Indian Annals of Med. Science*, Oct. 1865. 'The symptoms of acute osteo-myelitis are pain in the part, œdema, and swelling extending down the limb; general fever, with quick pulse, and increased temperature, and more especially the recession of the soft parts, including the periosteum, from the bone, which is then left denuded at the bottom of the wound.'—*St. George's Hospital Reports*, vol. i. p. 156.

otherwise prove fatal; but when this affection is limited to a portion only of the bone, the expectant treatment is indicated, and the patient may recover after the extraction of a sequestrum.[1]

Chronic abscess.—Limited suppuration, or abscess in the cancellous tissue, is an affection which is fortunately far more easily recognised, and far more under the control of surgery, than osteo-myelitis. It hardly needs to be said that this condition of bone was first discovered and described by Sir B. Brodie.[2] The symptoms are not always very clear, but a careful study of the case seldom fails to establish the correct diagnosis. The seat of the disease is almost always the articular extremity of the bones which form one of the great joints—knee, ankle, or elbow. The tibia is more frequently affected than any other bone, and usually at its upper end. Chronic abscess may, however, occur in any situation.[3] The abscess is almost always situated on the superficial side of the bone, and is probably occasioned, in most cases, by external violence, or other causes, acting on that surface; but the history is often obscure, in consequence of the chronic nature and insidious progress of the malady.

The symptoms are, a dull aching pain in the part, often worse at night than during the day, liable also to other remissions and exacerbations, and increased by exercise or pressure. In most cases the bone is especially tender at one particular spot, where the abscess has advanced nearest to the surface, and there is slight tumefaction of the soft parts over it. Sometimes, but not always, a little enlargement of the bone itself may be made out. There is perhaps nothing very characteristic in these symptoms taken separately, or on a first examination; but the persistence of the whole assemblage of them for a considerable period of time, and in spite of judicious treatment, directed to subdue an inflamed condition of the bone, will be reasonable ground for the diagnosis of chronic abscess, and more especially if the neighbouring joint be unaffected. The localised, and very circumscribed, tenderness is perhaps, when well marked, the most unmistakable symptom.

The condition of the diseased bone testifies very clearly to the nature of the morbid process, so that few museums are without some of these preparations. The following is Sir B. Brodie's description of the first preparation which he dissected:[4] 'The lower end of the tibia is enlarged, and the surface presents marks of great vascularity. The bone in the preparation is divided longitudinally, and just above the articulating surface there is a cavity as large as a small chestnut. This cavity was filled with dark-coloured pus. The inner surface of it is smooth. The bone immediately surrounding it is harder than natural.'

If the case be allowed to proceed beyond this stage, serious and frequently fatal mischief may ensue from the extension of the abscess into the neighbouring joint. Before this event occurs, however, the patient may be much inconvenienced by repeated attacks of swelling and pain in the joint when he attempts to use the limb, the effects of slight synovial inflammation set up by the neighbouring abscess. Rest and cold applications will generally remove these symptoms, but only to recur as soon as the patient again attempts to move about. On the cure of the abscess they will immediately and permanently disappear. When the abscess has burst into the joint, the affection of the bone becomes merged in the more serious injury to the articulation.

Treatment.—In all cases, as soon as the diagnosis has been so far settled as to satisfy the surgeon that operative interference is justifiable, he ought to explain the

[1] I would refer, on the subject of chronic and acute osteo-myelitis, to the well-known paper by M. J. Roux, read before the *Académie Imp. de Méd.*, and to the criticisms of M. Legouest, M. Larrey, and others on it, which are to be found in the Society's *Bulletin* for 1859–60, vol. xxv.; to a paper by Mr. Longmore, in *Med.-Chir. Trans.* vol. xlviii.; and to one by myself, in *St. George's Hospital Reports*, vol. i., quoted above.

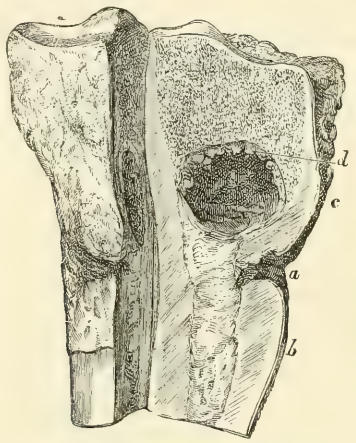
[2] *Lectures on Pathology and Surgery*, ed. 1846, p. 395.

[3] In the Museum of St. Thomas's Hospital there are examples in the body of a rib, in the clavicle, and sternum. Series C., Nos. 84, 84^2, 85.

[4] *Op. cit.* p. 397. The original preparation is in the Museum of St. George's Hospital, series ii. 30.

nature of the case to the patient, and endeavour to obtain his consent to the simple operation which will at once establish the diagnosis and cure the disease; or the diagnosis may be confirmed by perforating the bone in the suspected spot with the hand-drill, as recommended by Mr. Macnamara.[1] The suspected part of the bone should be well exposed by a crucial incision. The bone should then be perforated to a considerable depth with a small trephine, which should not have a shoulder. If one spot on the surface of the bone appears softer than another, this should be selected for the centre of the opening. Very often pus will be seen welling up in the groove, as soon as the trephine has penetrated the compact wall of the bone. The instrument may then be withdrawn, and on the circle of bone being raised with an elevator, the pus will be evacuated. The cavity exposed is lined with a thick 'pyogenic' membrane, and its surface is very sensitive. The pus is only in small quantity (generally about a tea-spoonful); but its evacuation suffices at once to relieve the patient of his wearing pain, and he is soon restored to perfect health, the cavity being filled up with a fibrous material, by which in all probability the excised piece of bone is ultimately reproduced.

Fig. 47.—Unsuccessful Trephining in chronic Abscess of Bone. (From a preparation in St. George's Hospital Museum. Series ii. No. 31.)



a, the point where the trephine has been applied about half an inch from the abscess; *b*, the wall of the bone, thickened by inflammation; *c*, the cavity of the abscess; *d*, the pyogenic membrane.

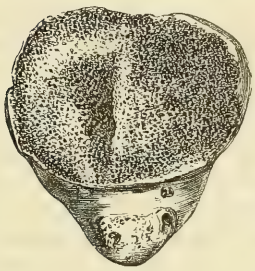
Two things may interfere with the complete and immediate success of this operation—the diagnosis may have been correct, but the place selected for trephining may have been not quite the right one; or the diagnosis may have been wrong, and the symptoms have depended merely on chronic ostitis or chronic osteo-myelitis. In the latter case, as may be seen by Sir B. Brodie's patient above referred to (p. 281, note), the operation will often do good, will relieve the pain of the inflammation, and perhaps prove the starting-point of a healthier action. It is well, however, remembering that this mistake has been committed by the best surgeons, to prepare the patient for it, so that he may not be too much disappointed if the surgeon shall afterwards have to confess that no abscess was found. If, however, the trephine do not come down upon an abscess, it should not be forgotten that this may depend on the opening having been made on one side of the abscess, which may be lying close to the trephine-hole, but separated from it by a thin bony septum. This is illustrated by the accompanying drawing from a preparation in the Museum of St. George's Hospital. It is advisable, therefore, when the pus has been missed, before giving up the operation, to pierce the walls of the trephine-hole in several directions with a sharp-pointed instrument, in order to remove the bone freely with a chisel if a drop of pus follow any of these punctures.

[1] *Diseases of Bones and Joints*, p. 61.

Caries.—The word caries will be used in the sequel as equivalent to the term 'ulceration of bone.' The term is now employed in very various senses, especially by the German surgeons; and so difficult has it thence become to follow its exact meaning in different works that Billroth proposes to abandon it altogether. This, however, would involve a change in accepted surgical nomenclature, and a consequent confusion for which we should obtain no compensation. I can see no difficulty or ambiguity in using the word 'caries' as I have here suggested, except perhaps in cases of inflammation of bone attended with absorption, but without suppuration or open sore—cases such as are spoken of on p. 293. To these I should apply the term 'inflammatory absorption,' or 'ulcerative absorption;' and it is to these that the term 'caries sicca' of the German surgeons appears most applicable; but such cases are so rare in practice that it matters little what name we give them. The simplest nomenclature seems to me to be that which calls cases of inflammation without suppuration 'ostitis,' and cases of ulceration 'caries,' adding to the latter

Fig. 48.—Strumous (or so-called 'carious') Ulceration of Bone. (Museum of Royal College of Surgeons, No. 625.)

Fig. 47a.—Simple Ulceration of Bone. (From a preparation (No. 607) in the Museum of the Royal College of Surgeons.)



name any qualifying designation, such as 'simple,' 'traumatic,' 'strumous,' or 'syphilitic.'

Superficial ulceration is distinguished by the following characters. The periosteum is loosened from the surface, and, if the disease is advanced, will be found much thickened, and converted into a villous mass of a pink colour, resembling a layer of granulations. This substance adheres very loosely to the surface of the bone, and when lifted up from it, it is found to fit into depressions, which seem to have been hollowed out of the bone by the agency of the granulations. The bone at a very slight depth underneath is found, in most cases of healthy inflammation, of the ordinary consistence of cancellous tissue, which it resembles in structure even in those parts which ought to be compact. In strumous caries, on the contrary, the osseous structure will be found softened and otherwise altered, as will be described when treating of struma in bone; and it is to this combination of strumous inflammation of the body of a bone with ulceration of its surface, that the old descriptions of caries appear to be intended to apply. The ulcerated surface in healthy inflammation is superficially excavated, much softened, and easily broken

down by the pressure of a probe. The interior of carious bone is softened by inflammation, its cancelli enlarged, and filled with the products of the softening and disintegration which have been going on around them. These products, as has been noticed above, are principally oil-globules, blood, and other débris of the soft tissues, and granular inorganic materials, having the same chemical composition as the salts of the bone. The soft tissues almost always take part in the morbid actions which lead to caries, and abscesses are formed which burst externally, and leave sinuses communicating more or less directly with the softened bone, and through which some part of its exposed surface can generally be felt with the probe. Abscesses, however, frequently form in the neighbourhood of inflamed bones without any actual communication with them. This is, perhaps, more peculiarly the case in childhood, and near the joints.

Symptoms.—The symptoms of caries are merely those of inflammation *plus* an abscess exposing softened bone; hence all that has been said about the frequent obscurity of the early stages of ostitis will apply to caries, and with greater force, inasmuch as these ulcerative actions are more prone to occur in the course of low inflammations. Constant pain, then, in the neighbourhood of a bone, with swelling and more or less loss of the function of the part, followed by abscess which will not heal, indicate usually that the abscess proceeds from ulceration of a bone; and this presumption is much strengthened if the pus have a putrefied, offensive odour, and a prominent mass of granulations project from the sinus; and it is converted into certainty if fragments of bone can be found in the discharge, or if the communication with the bone is sufficiently direct to allow of its being struck with a probe. When carious bone is touched by the probe, it is not usually found particularly sensitive, perhaps is not sensitive at all; it bleeds readily; its surface is irregular, and may generally be felt to be soft. When the opening is sinuous and the bone cannot therefore be struck, the diagnosis can of course only be inferential, and founded mainly on the persistence of the symptoms. Chemical analysis of the pus may also sometimes assist the diagnosis, since the pus from diseased bone contains more phosphate of lime than that from soft parts.[1] Sometimes the patient's sensations afford valuable evidence, more particularly in caries from healthy inflammation, where striking lightly over the carious part often causes the same kind of sharp pain as is felt when a carious tooth is struck. (See also footnote [2], p. 279).

Caries is generally accompanied by more or less of plastic or organisable effusion in the bone in the neighbourhood of the ulcerated spot, leading to condensation of the deeper parts of the bone, and to periosteal deposit of bone on the surface. This, however, is the case only in those instances where the process partakes of the healthy or sthenic character. In those low inflammations which are usually called strumous, whether connected with obvious deposit of tubercle or not, such thickening or periosteal deposit is often absent; but the bone is softened throughout all the affected portion, the disintegration becoming less and less perceptible at a distance from the part where the loss of substance exists. The deposit around ulcerated bone frequently leads to anchylosis of the less movable joints; an occurrence which is extremely common in the tarsus.

In cases of superficial ulceration of bone, the agents for its removal are either the periosteum, when that membrane remains entire, or the granulations which spring from inflamed surrounding parts when the periosteum has been removed. Other cases, however, of ulceration are met with, in which the disease is more deeply seated, and commences in inflammation of the membrane lining the cancelli or medullary cavity, and where, therefore, the agents for the removal of the bone are to be sought in the vessels of this membrane. Such cases as these are very rare. I am able to refer to preparations showing the reality of the affection,[2] but I have no knowledge of the special symptoms which it presents, or the indications, if any, which it furnishes. It is evident that, shut up as the inflamed parts are in the interior of the bone, the products of inflammation can find no exit, and the disease

[1] Bransby Cooper, *Lectures on Surgery*; Barwell, *On Diseases of the Joints*, p. 238, 1861.

[2] St. Bartholomew's Hospital Museum, series i. No. 163.

must soon become merged in one involving more extensive destruction, *i.e.*, in diffused suppuration or internal necrosis.

Ulceration in bone, like ulceration in soft parts, may terminate in cicatrisation, or the reproduction of an inferior kind of bone which is less vascular, and less smooth and well formed than the portion which it replaces. This fortunate termination becomes less probable, the deeper the disintegration of the bone extends, and the more profound is the constitutional cachexia with which it is associated. In extensive strumous caries it is hopeless.

The *treatment* of bone affected with this form of inflammation is a matter of great importance; since upon the success or failure of such treatment, the preservation of the bone, and with it sometimes of the limb, or even the life of the patient, may depend. Ulceration in bone does not differ materially from the same process in soft parts, except in the far greater length of time which it usually occupies. In the bone, as in soft parts, the powers of nature will in most cases suffice for cure, when cure is possible, if the parts be put in a suitable position, kept at rest, and preserved clean and free from the accumulation of the discharges. But often the patient cannot wait for the completion of this natural process, and calls upon the surgeon to deliver him from the chronic malady which has become insupportable. Or, sometimes his health gives way under the protracted discharge; or, after an interval of quiescence, the caries again makes progress, and threatens to involve neighbouring bones, and to impair the functions of the whole limb, if not arrested. This is more peculiarly the case in the tarsus, and other 'irregular' bones. In the ordinary treatment, then, of caries, no other local measures are required than to provide a free exit for the discharges, and to keep the exposed surface of bone clean. The appropriate constitutional treatment will complete all that art can do to promote recovery, and more active surgical interference is not only useless but hurtful, as it risks doing harm without a reasonable prospect of doing much good. Incisions, however, should not be spared to the utmost extent necessary to keep the discharge free, or perhaps even somewhat beyond this limit. In fact, in all the acuter cases of ostitis, much benefit appears to follow the mere division of the tense structures over the bone. When the surface can be felt exposed and carious, it is still more necessary to have a free discharge; since otherwise, the pus, being confined, may burrow beneath the periosteum, and extend the mischief to the neighbouring parts of the bone.[1] Mr. Lister and his scholars lay much stress on the employment of the antiseptic method in such cases. The bone being freely exposed, and, if necessary, perforated with the trephine, the wound is to be kept perfectly 'aseptic,' and will then heal gradually.

Often after this free exposure of the carious bone, the disease will gradually subside; but when this is not the case, the question occurs, whether it will be proper to attempt to remove the carious surface and expose a more healthy one, either by rasping or gouging the bone, or by the application of the actual cautery; or to modify the diseased action by injections, or by applications to the carious part.

In cases of superficial caries of bones which can be exposed without too much injury to the soft parts (of which the tibia and calcaneum are the most familiar examples), it may sometimes be advisable to rasp or gouge away the carious surface of the bone, and endeavour to arrest the further progress of the disease by the application of the actual cautery or strong nitric acid to the surface so exposed; or, if the disease be very superficial, the latter measures may be sufficient, without any preliminary removal of bone.

Mr. Pollock has employed the application to the carious surface of sulphuric acid, at first diluted with an equal bulk of water, and then more and more nearly pure, pencilled on the surface when exposed by turning away the soft parts. The first application dissolves a portion of the exposed bone, and chars and kills the rest of the surface; when this comes away, if more dead or diseased bone is exposed, it

[1] Some authors teach that pus exercises a solvent power upon the bony tissue itself. This doctrine appears unsupported by direct evidence; and it seems improbable that the bone can be so dissolved while it retains its vitality.

can be similarly treated until a healthy granulating surface is reached. In this way also superficial exfoliations of necrosed bone can be removed. I have witnessed the success of this plan in the hands of my colleague, and can speak also favourably of it from my personal experience.

Another plan, which is applicable also to the treatment of caries in more deeply-seated bones, has been proposed by Dr. Fitzpatrick.[1] He converts the sinuses leading down on to a diseased bone into a large funnel-shaped opening, by the repeated action of the Vienna paste (potassa cum calce), and having thus brought the diseased bone within reach, he pierces its tissue with a strong knife, trocar, or small trephine, and then freely cauterises the full extent of the perforation. The cauterisation is to be repeated till the whole extent of the disease seems to be removed, and the use of the limb is restored. Necrosis can, according to Dr. Fitzpatrick, be treated in the same way: 'the caustic being very freely used, destroying all foul undermined integument, and leaving large clean circular openings, more than an inch in diameter, and extending deeply down into the sequestrum, into contact with which the caustic in stick and powder is to be freely brought.' He recommends it also in simple inflammation (a recommendation in which I cannot say that I concur), but not in diffused suppuration. My personal experience of this treatment has been limited, and in one case which seemed peculiarly well suited for the treatment, and where the disease, which was seated in the ankle, was in a perfectly chronic state, the patient died of pyæmia.

These operations should, however, only be performed in cases of evident necessity. We have only too frequent instances of the dangers of all operations on bone, especially of such as involve the exposure of large surfaces of the cancellous tissue, as is generally the case in these gouging or rasping proceedings, which are extremely apt to be followed by diffused inflammation of the interior of the bone (osteo-myelitis) and by pyæmia. Still, if the disease be accompanied with much pain and loss of motion, and the wound show no tendency to heal, the patient is often compelled to have something done for his cure, as otherwise he would lose his means of livelihood; or the surgeon may think it right to interfere in order to arrest the progress of the disease into neighbouring organs. The decision of such questions as these must, of course, be left to individual judgment.

The application of the actual or potential cautery appears to be less dangerous than cutting operations, and is often successful in superficial caries. It seems less in use than might be expected, considering the many cases of caries limited to one, and that a superficial, bone of the tarsus and metatarsus, which are seen, especially in children. Here, however, and in all situations where a bone can be removed without prejudice to the function of the part, excision is so much more satisfactory when any large part of the bone is involved, that it is, perhaps, not wonderful that the less radical measures are not much in use.

M. Sédillot has proposed a more extensive use of the operation of scooping or gouging carious bone, as a substitute for excision or amputation.[2] His plan contemplates the removal, by the gouge, of the whole bone except a shell of the outer healthy parts, which is left to effect the restoration of the bone. With all due respect for the authority of M. Sédillot, it seems impossible to allow that such a proposal is either useful or safe. There are few cases of extensive and deep-seated caries in which the limits of the disease can be ascertained, and a partial operation is often worse than none at all. Besides, extensive exposure of the interior of a bone is a most hazardous proceeding, and only too often terminates in pyæmia. M. Sédillot, however, is said to have performed his operation thirteen times without any instance of such complication. The further consideration of this question will occupy a portion of the essay on Excisions.

Ulceration in bone is not always of this chronic nature. Mr. Stanley has described[3] some cases of 'phagedænic ulceration' of bone which seem to have been

[1] See *New Syd. Soc. Biennial Retrospect*, 1867–8, p. 259.
[2] *Lancet*, Dec. 10, 1859; Sédillot, *Sur l'Evidement des Os.*
[3] *On Diseases of the Bones*, p. 65.

connected with the occurrence of rodent or cancroid ulcer[1] in the soft parts; and in diseases more distinctly partaking of the nature of cancer the bones may be destroyed with great rapidity; but here the affection in the bones is only a part of the general disease, and its treatment must depend on the view which may be taken of the latter. Cases of rapidly spreading ulceration do, however, occur, in which the bone alone is affected.

Two remarkable instances have been put on record by Mr. Cæsar Hawkins;[2] in one of which the disease was only part of a general strumous affection, but peculiar on account of its extreme rapidity and great extent. The other was a very remarkable instance of removal, by disease, of great part of the skull-cap, and protrusion of the brain through the opening so left; but without the formation of pus. An abscess was found in the brain, but this was connected with violence done to the protruded portion of that organ, and not with the disease in the bones. No distinct proof of the presence of any constitutional cachexia was obtained, nor was the exciting cause of the complaint apparent. Its inflammatory nature was testified by distinct marks both of inflammatory thickening and of inflammatory erosion on the bone in the neighbourhood. Therefore the old definition of ulceration as 'absorption from inflammation' would strictly apply to this extraordinary case; but it is rarely indeed that so large a portion of bone is removed without the formation of abscess, especially when compact tissue is involved. Norris, however, in his 'Contributions to Practical Surgery,' p. 55, has recorded a very singular case in which, after a simple fracture of the arm, reproduced by a second accident during the uniting process, the whole humerus gradually became absorbed, without any formation of matter. The patient survived the injury thirty-four years, and the fact of the total disappearance of the whole shaft of the bone, leaving only a small piece at either extremity, was verified by dissection. A somewhat similar case occurred in Mr. Wheelhouse's practice.[3]

Necrosis, or the death of some considerable portion of a bone, occurs as the consequence of any cause which sufficiently impedes the circulation in the neighbourhood This is precisely analogous to what takes place in the gangrene of soft parts; and as in gangrene the non-vascular parts are most easily affected, and then those which, though vascular, are furthest from the centre of the circulation, and in which the vessels are fewest and smallest, so the frequent occurrence of necrosis of bone is, no doubt, due to the comparatively small quantity of blood which circulates in that tissue, as well as to the inextensible nature of the osseous substance itself, in consequence of which any extravasation or product of inflammation causes pressure directly upon the blood-vessels, or narrowing of the channels for the conveyance of the nutritive plasma.

The same causes which produce gangrene in soft parts will occasion the death of a bone; and among them inflammation holds a high place, less on account of its direct effect, *i.e.* its tendency to produce the death of the part inflamed, than of its indirect consequences, whereby the circulation around the inflamed part is obstructed, and so necrosis of the neighbouring parts is induced. Hence in the course of an extensive caries the circulation of some considerable portion of the bone is apt to be destroyed, and then a necrosed or loose piece is found in the middle of the ulcerated part.[4]

Another very frequent, if it be not the most common, cause of superficial necrosis is the denudation or separation of the periosteum, which occurs as a consequence either of direct injury or of effusion between it and the bone. It is true that large separations, and even extensive destruction of the periosteum, may occur without the death of any portion of the bone, and this is indeed common in the bones of the head and face; but the peculiar circulation in the former, and the great vascularity of all parts in the latter region, sufficiently explain this fact. In other parts, it is the more general rule that when the periosteum is destroyed or separated over any considerable

[1] See vol. i. p. 154.

[2] *Med.-Chir. Trans.* vol. xxxix. p. 285.

[3] In the *Wiener Med. Wochensch.*, Dec. 7, 1878, Nedofil relates a case in Billroth's practice in which almost the entire radius was absorbed in a case of constitutional syphilis with much pain and swelling, but without suppuration. In a note to this paper Billroth refers to other instances of absorption without suppuration.

[4] This combination of caries and necrosis was called by the old writers 'dry caries' or 'hard caries.' It is a different condition from that which modern German pathologists intend by 'caries sicca.' That term appears to me to be applied, in a very loose and unintelligible way, to several varieties of ostitis. See p. 289.

portion of a bone, the superficial layers of the latter will perish. This is one reason, among many, why it is important to adjust the soft parts over a bone denuded by violence, in order that they may rapidly adhere to it, and that so fresh vessels may connect the periosteum to the bone before the latter has undergone an irremediable change.

Violence, acting directly upon the bone, is another very frequent cause of necrosis, as is frequently seen in compound fracture, where both the periosteum and the medullary tissue are much damaged, and the bone dies without any proof of previous inflammation having existed.

The action of cold is often exhibited on the bones as on the soft parts, and they frequently suffer in frost-bite (vol. i. p. 129). In deep burns the bones are also occasionally charred, and they are frequently involved in gangrene of the superficial tissues, from whatever cause it arises. Certain caustic applications are well known as frequent causes of necrosis, of which the superficial exfoliation produced on the surface of the jaw for the cure of epulis is a familiar example. To this category belongs also the necrosis of the jaw which is produced by exposure to the fumes of phosphorus.[1] The various constitutional cachexiæ, especially syphilis and struma, are frequent causes of necrosis; but here the affection of the bones is only a variety of the inflammatory process.

The abuse, and even occasionally the moderate use, of mercury is another cause of necrosis. It is quite true that many of the preparations and cases entitled 'necrosis from the abuse of mercury' may be explained as having been cases of syphilitic necrosis, in which mercury had merely failed to arrest the disease, and had had nothing to do with causing it; but there are too many instances on record of the occurrence of necrosis of the jaw, during the administration of mercury for some disease which has no influence upon the bones, to admit of a doubt that the affection was directly induced by the so-called remedy. Thus, in the Museum of Guy's Hospital (No. 1,091) is a sequestrum consisting of two-thirds of the alveolar process of the lower jaw, which is said to be 'necrosis induced by the use of mercury for ovarian dropsy.' In the Museum of St. Bartholomew's Hospital is a preparation, in which necrosis of the jaw is attributed to the administration of a few grains of mercury during a fever; but in some fevers necrosis has been frequently observed as a consequence of mere lowering, as it would seem, of the vital powers, or some morbid condition of the blood, without any mercurial cachexia.[2]

It would be idle to attempt an enumeration of all the causes which may lead to the death of bone. The above are the most common, and will be found sufficient for practice. The symptoms and treatment are identical in most of these forms. Some will require special notice hereafter.

When a portion of bone is to die,[3] the first phenomenon is the cessation of circulation in it. This leaves it hard, white, and sonorous when struck. It does not bleed when exposed or cut into, and is insensible. Occasionally, when the dead bone is exposed to the air, and acted on by the presence of putrid pus, its colour becomes nearly or quite black; large surfaces of hard, black, necrosed bone are sometimes left exposed by the sloughing of the skin over the tibia. The dead bone at first retains its connection to the bone around, as well as to the periosteum, or whatever part of the nutrient membrane may belong to it; but the presence of a dead part is never long tolerated by the living tissues, and accordingly the processes which are to eliminate it soon become perceptible on both these structures. The periosteum, or medullary membrane, as the case may be, separates from the dead bone and becomes inflamed, a quantity of ossific deposit (more or less, according to various circumstances) is poured out between it and the dead bone, and this deposit soon becomes

[1] This affection will be found treated of in the essay on SURGICAL DISEASES OF THE TEETH AND GUMS.

[2] See, in the Museum of St. George's Hospital, series ii. Nos. 91, 95, preparations in which both the jaw and the clavicle became necrosed in the same patient during the course of the fever.

[3] This description refers to the process as it occurs in bone previously healthy.

converted into new bone, forming a sheath over the dead portion, by which the latter is enclosed, or *invaginated*, as the technical term is. The dead part is now called a *sequestrum*, a name only properly applied to it when loose and invaginated, though often incorrectly used of any piece of dead bone. While this sheath is being formed from the membrane coating the dead bone, changes are going on in the living bone to which it was attached. When the latter has been previously diseased (*i.e.* when the necrosis has been of inflammatory origin), the inflammatory deposit which surrounds the sequestrum softens, pus is formed, and a groove of ulceration is produced at the expense of the circle of inflamed bone which forms the margin of the sequestrum. If the surrounding bone have been previously healthy, the sequestrum acts as an irritant upon it, setting up, first inflammation and thickening to a variable distance, and then ulceration. Thus a groove is traced around the sequestrum; and the formation of this groove is accompanied by suppuration, as has been described above (see p. 278). The pus formed in the neighbourhood of the dead parts makes its way to the nearest surface, and in so doing interrupts the formation of the

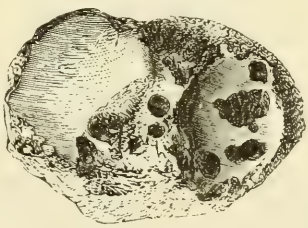


Fig. 49.—From a preparation (No. 3174) of Necrosis of the Tibia, in the Museum of the Royal College of Surgeons. To show the various points connected with necrosis of a portion of the shaft of a long bone—the sequestrum—its invaginating sheath, formed in a great measure by periosteal deposit, and terminating on the healthy surface of the bone, at some distance from the seat of disease, the openings, or cloacæ, through which the sequestrum is exposed, and (in this instance) the implication of the neighbouring joint from the extension of these cloacæ into it.

periosteal sheath, leaving sinuses, or *cloacæ*, passing through this sheath from the sequestrum to the surface of the body, or sometimes into a neighbouring joint or serous cavity. The presence of such sinuses, leading through the shell of bone to hard, smooth, sonorous bone at the bottom of the cavity, is the distinguishing mark of necrosis. Most of these points are illustrated by the accompanying figure.

The formation of the groove between the dead and living bone is a very slow process in the bones of the limbs, requiring generally many months for its completion. It is impossible to lay down any rule as to the time at which a sequestrum may be expected to be found separated from the rest of the bone. In animals, as has been proved by experiments,[1] the process may be completed in a few days. In children it seems to go on sometimes with great rapidity, especially in the bones of the face. On the other hand, instances are not wanting in which half a lifetime may have elapsed, and the process still remain unfinished.

One of these has furnished a preparation in the Museum of St. Bartholomew's Hospital.[2] It is the section of the shaft of a femur, exhibiting in its interior a small fistulous cavity, with necrosis of a small portion of the inner layers of its wall. A groove extends to some

[1] Troja, *De novorum Ossium Regeneratione*, exp. i.

[2] Series i. No. 176.

depth between the dead and the contiguous living bone. The limb was removed by amputation. The femur had been fractured thirty-five years previous to the amputation; the fracture was followed by abscess in the soft parts, and the formation of a fistulous passage leading to the interior of the bone, which passage remained open during the whole period from the fracture to the removal of the limb.

It may, however, be stated generally, that the more superficial the dead portion is, the more freely it is exposed, and the more violent the action of the cause has been, the more rapidly will it separate (see p. 284).

When the groove is completed, the dead bone is loose in the cavity so formed for it, and quite free from any vital connection to the body. The sequestrum, therefore, is now eliminated, and this may be regarded as the natural process of cure, since it prevents the extension of the necrosis further into the bone; but as the sequestrum is still lodged in its cavity in the interior of the bone, it thus becomes an abiding source of life-long irritation, which must by all means be removed as speedily as possible.

The above is intended for a sketch of the process of necrosis in one of its most frequent seats, viz. the outer (subperiosteal) layers of the compact sheath of a long bone; but it may occur in any situation—in the medullary canal, or central layers of the compact tissue, in flat or irregular bones, or the spongy ends of long bones; or again, the extent of the necrosis, or the situation of the part, may modify considerably the process of separation, *i.e.* the surgical aspect of the case. For example, even when necrosis is subperiosteal, and the process of separation normal, it may be in a part from which extraction is impossible, as on the inner surface of the skull, spine, pelvis, thorax, &c. The subperiosteal sheath is often wanting in the bones of the limbs when the soft parts have been extensively destroyed over the affected bone; and it is never formed in the skull, where necrosis is so common, nor in the cancellous bones, where, though less common, the disease is by no means rare. In such cases, when the dead bone is loosened from the living, it comes away of itself, or can be at once removed. Such a piece of dead bone, not confined by an invaginating sheath of new bone, is called an *exfoliation*. Again, it sometimes happens that the necrosed portion involves the whole thickness of the shaft of a long bone, and sometimes the whole length of its diaphysis; some instances even are exhibited in the museums where the epiphysis also has perished along with the entire shaft, though this is very rare.[1] Necrosis also sometimes attacks the epiphysis only, and even the deposit of bone which in early life forms the centre of ossification for the epiphysis.[2]

Each of these conditions is accompanied by noticeable peculiarities. When the whole thickness of the shaft is involved, especially in a bone, like the humerus, enjoying free and rapid motion, fracture is likely to follow on the completion of the groove, although this result may be obviated by the strength of the case of new bone. When the whole diaphysis is involved, the case assumes a graver aspect, since the extent of inflammation which is necessary for the formation of the new shaft, and the great suppuration thereby produced, suspends, or perhaps permanently abolishes, the functions of the limb. The muscles become matted together, the skin œdematous and penetrated by numerous sinuses, the parts below incapable of extended motion or energetic action; cases even are on record where the inflammation having reached the great vessels, has produced coagulation of the blood in both artery and vein, and consequent dry gangrene of the limb.[3] In other cases either the ulceration around a sequestrum, or other disease of the bone, involves a large vessel, or the point of an exfoliating portion of bone is driven into the artery in some movement of the limb;[4]

[1] Guy's Hospital Museum, No. 1160^{30}, necrosis of the condyles and shaft of the femur, and upper end of the tibia. See also No. 1160^{218}, referred to farther on.

[2] See the section on Epiphysitis in the essay on DISEASES OF THE JOINTS.

[3] Museum of St. Bartholomew's Hospital, series i. No. 134.

[4] Mr. Poland, in his essay 'On Rupture of the Popliteal Artery,' quotes one case of spontaneous hæmorrhage from that vessel in necrosis of the femur (a patient of Dr. Porter, *Dublin Journ.* vol. v.), and two others where the artery was wounded by a sequestrum during active movements of the limb (Dr. Byron's case, *Med.-Chir. Rev.* vol. xxiv. p. 259; Dr. Jacob's *Diss. Med.-Chir. de Aneurism.* Edin., 1814). I have seen fatal hæmorrhage from the lingual artery in disease of the jaw, and from the aorta in caries of the spine. Mr. Stanley (*op. cit.*

and thus either a direct wound of the artery is produced (when the sinus of the diseased bone communicates with the laceration in the artery), or if no opening exists externally, a consecutive aneurism may possibly be established. In any case of such injury to the main vessels, when the diagnosis can be properly established, amputation would be indicated in the lower limb. In the upper limb the main arteries are separated from the bone by a mass of soft parts; and smaller vessels would hardly complicate the case, as they might be included in the incisions required to expose the diseased bone. In other situations attempts must be made to tie the ulcerated vessel; and if they fail, as they generally will, from the rotten condition of the parts, the trunk leading to it must be secured.

In cases of necrosis involving the whole thickness of a bone (*total* necrosis), when the seat of the disease is a large bone, such as the femur, life is in considerable danger; and as the patients are usually persons in whom some constitutional cachexia is present, and probably in an advanced stage, they frequently succumb. Still the dangers of amputation in these cases are so great, and the advantages of saving the limb so decided, that they are usually left to the reparative powers of nature. In small bones, such as the phalanges, amputation is indicated. In the upper limb large portions of the whole thickness of the shaft may be removed with entire success, and preservation of the motions of the extremity. In the essay on Excision, the indications for excision of the whole or parts of bones on account of necrosis, involving their whole thickness, will be further considered.

Central necrosis is usually an obscure complaint, and is hardly distinguishable by its symptoms from chronic abscess of the bone. In fact, as their symptoms are the same, so the same treatment is applicable to each of them. Deep-seated pain, throbbing, loss of rest, general debility, perhaps rigors and some amount of fever, with slight puffiness over the seat of the disease, and a little pain on pressure; these symptoms persisting for a considerable period without relief, notwithstanding that the appropriate constitutional and local remedies have been employed, indicate the necessity of making an exploratory incision at the seat of the inflammation, and, if the surface be found healthy, of removing it with the trephine in order to search for an abscess or sequestrum in the centre.

Mr. Morrant Baker [1] has called attention to the occasional occurrence of necrosis unaccompanied (at least for a very considerable period) by any suppuration. In the case which formed the text of Mr. Baker's paper, symptoms of disease in the femur had lasted ten weeks, and spontaneous fracture had occurred four weeks before amputation, which was performed at the hip, under the impression that the disease was malignant. On examination, it was found that nearly the whole shaft of the femur was necrosed, and the necrosed parts were separated from the periosteal bone in the greater part of the limb, yet no pus was found. In this instance, Mr. Baker believes that the necrosis was the result of chronic inflammation, leading to deposit of new bone, both on the periosteal and endosteal surfaces (a condition to which he gives the name 'intraosseous necrosis'), by which deposit the already defective circulation in the sclerosed shaft was obstructed, and thus the latter was made to die. He also gives other examples in which necrosis seems to have existed without any observed suppuration, and refers to a paper by Sir J. Paget on 'Necrosis of the Femur without External Inflammation,' 'Clin. Soc. Trans.' vol. iii. 183. The fact is very important in a surgical point of view, since in these cases the dead bone may be so extensive, and so locked in by the invaginating sheath, as to be quite irremovable except by amputation; and again the resemblance to malignant disease is often very great.

Deep-seated necrosis often leads to suppuration, making its way to a free surface. This is very common in the long bones, and is a frequent cause of abscess and destructive inflammation of the joints. Necrosis may also attack a portion of the articular surface of one of the great joints of the body, although this is rare except as

p. 111) relates a case in which the capsule of the knee-joint was penetrated by the pointed end of the necrosed shaft of the femur.

[1] 'On Necrosis without Suppuration,' *Med.-Chir. Trans.*, vol. lx. 187. See also Colles, *Dublin Journ. of Med. Science*, Dec. 1878.

a complication of extensive strumous affection of the joint-surface. Limited necrosis of articular ends is, however, occasionally met with, and, like the previous affection, will set up abscess in the joint. The diagnosis of these causes of articular abscess must be sought in the essay on DISEASES OF THE JOINTS, and the indications for operative treatment in that on EXCISION.

In the flat bones, where they are formed of compact tissue, necrosis is an exceedingly common disease; but here, as has been before observed, the dead bone will usually exfoliate without invagination. The same may be said of the necrosed portions of irregular bones, which consist almost entirely of cancellous tissues (such as those of the tarsus), in which necrosis is by no means rare. Whole bones, or large portions of entire bones, of the tarsus, and sometimes, but less often, of the carpus, are found quite separate from all their attachments, and merely retained as foreign bodies among the soft parts. In such cases there is sometimes a little difficulty in making the diagnosis; since the dead bone has not the hard ringing sensation usual in necrosis of compact tissue, and the large size of the necrosed piece sometimes prevents it from moving under the probe. The case, therefore, simulates one of caries. A free incision will solve the question.

However, though the cancellous tissue is sometimes affected with necrosis, it should be remembered that this is exceptional, and that necrosis is an affection more peculiarly of the compact tissue, and especially of the densest bones. Thus the petrous bone is frequently necrosed, and has been known to exfoliate almost entire.[1]

Treatment.—Hitherto we have been considering the usual method of separation; and as this is a long and tedious process, seldom completed under many months in the case of a large sequestrum, and often dating by years, it is not surprising that efforts should have been constantly made to anticipate the period of cure by cutting away the diseased bone. These, however, have hitherto resulted in disappointment. The process must be left to find its natural completion in the spontaneous separation of the dead bone from the living; and any attempt to effect this by operation, *i.e.* to detach the necrosed portion, and to cut it away from the living parts, only extends the area of the disease, and endangers the preservation of the limb. Special considerations, applicable to some regions of the body, such as the skull, may indeed induce a surgeon to operate on necrosed bone before it is loose, for the relief of matter pent up below it: such operations, however, are not undertaken with a view of curing the diseased bone, but of restoring the function of organs secondarily affected. Such has been the result of surgical experience up to the present time. I have, however, pointed out above (p. 292), that a sequestrum of limited extent may be dissolved out by the action of sulphuric acid, and thus the slow process of vital action necessary for its separation may be anticipated. In order to obtain success, however, in these proceedings, it is essential to know exactly the limits of the disease.

But when the sequestrum has separated and lies loose and invaginated in new bone, surgical interference is most necessary. There is perhaps no part of surgery in which the improvements effected in comparatively modern times have done so much to preserve life and limb, and to obviate pain, as in the treatment of necrosis. The invaginated portion of bone can never get out by any natural process: the very completeness and efficacy of the efforts which nature makes to preserve the continuity of the bone, and to restore its strength, effectually imprison the dead portion. Small pieces or granules of dead bone constantly exfoliate from carious surfaces; but when the sequestrum is of any considerable size, the cloacæ are never so large as to admit of the escape of the sequestrum through them, although sometimes they are very nearly large enough. Thus, in the Museum of St. Bartholomew's Hospital, there is a curious specimen,[2] in which a small piece of loose bone, just too large to get out of any of the numerous cloacæ which have formed around it, is found rattling about in its cavity as if in a dice-box.

The requisite operation consists in cutting down on the dead bone, and exposing

[1] *Path. Soc. Trans.* vol. vii. p. 335. A similar case occurred at St. George's Hospital, under Mr. Prescott Hewett's care; Museum, St. George's Hospital, series ii. 99.

[2] Sub-series, A, No. 94.

it sufficiently to remove it. If the necrosis be superficial, nothing is required beyond turning back the soft parts, which have no connection with the dead bone, elevating the latter, and pulling it out with a pair of forceps. But, for the removal of an invaginated sequestrum, it is necessary to open the sheath by enlarging one of the cloacæ with the trephine, chisel, osteotrite,[1] or cutting forceps, until it is large enough to admit of the extraction of the piece. Sometimes, when the sequestrum involves a large portion of the shaft of the bone, it may be found impossible to get the piece away until a pair of cutting forceps or a trephine has been introduced through the enlarged aperture, and the dead bone divided. In the necrosis which so often attacks stumps after amputation, a ring-like piece may separate from the end of the divided bone. Its extraction is then a matter of considerable difficulty; but still, as there is a free opening on to the extremity of the dead bone, it may be accomplished with some little trouble. If a similar sequestrum should form on one of the long bones, involving a ferule-like portion of its surface, its removal would be still more troublesome, requiring free incisions on both sides of the limb: but I am not aware that such cases have been noticed in practice. A preparation in the Museum of St. George's Hospital (series ii. 75) shows a strip of necrosed bone winding spirally, for a considerable distance, round the shaft of the humerus.

It has sometimes been made a question whether the sequestra of necrosed bone can be removed by a gradual process of disorganisation and molecular decay. If this question be proposed as an essay in scientific pathology, there is no doubt of its great interest; but, viewed as a practical consideration in surgery, hardly any value attaches to it. Experiments on animals certainly appear to show the possibility of the removal of small pieces of excised bone reimplanted in the excision-wound;[2] and it is possible that, in the human subject, sequestra of bone may be to some extent eaten away by a process of absorption like that which sometimes removes the ivory pegs driven into bones for the cure of ununited fracture (see FRACTURE);[3] but even allowing all upon this head which any one could reasonably deduce from such facts as these, we should still be justified in saying that the process is so slow, so uncertain, and so partial, that no account ought to be taken of it in surgery.[4]

It is therefore necessary, in every case in which a sequestrum forms, that a surgical operation should be undertaken for its removal. The word *sequestrum* is here used in its strict sense, to express a portion of dead bone contained in a case of new bone. An *exfoliating* portion of bone may separate and be thrown off by the natural processes, though it is usually necessary to facilitate its removal when loose by incisions.

As a general rule, the dead bone ought to be removed as soon as it can be ascer-

[1] Numerous instruments have been devised for the enlargement of cloacæ, and removal of the periosteal sheath in cases of necrosis, of which it is impossible here to discuss the value. Two of the most generally useful are Linhart's chisel, described by me in *Clin. Soc. Trans.* vol. ix. p. 122, and Marshall's osteotrite, an instrument resembling on a large scale the 'rosehead drill' used by dentists. By working this in a cloaca an opening large enough to admit the finger is rapidly and safely made.

[2] Heine, in *Gräfe und Walther's Journal*, Bd. xxiv. p. 527, quoted by Wagner, *op. infra cit.* p. 146.

[3] A case showing this absorption very clearly has been put on record by Prof. Cleland, in the *Brit. Med. Journ.* for Feb. 22, 1868.

[4] It may reasonably be doubted, also, whether the absorption said to have occurred in some of the experiments above referred to did really did place, or whether the whole thing was not a mistake on the part of the experimenters. Gulliver's experiments (*Med.-Chir. Trans.* vol. xxi.) show that portions of loose bone, thrust into the tissues of living animals, may remain an indefinite time without experiencing any absorption, as proved by careful weighing at the beginning and end of the experiment. Again, cases such as that quoted on p. 295, prove that a portion of bone, of no extraordinary size, may remain necrosed during a great part of a lifetime, and suffer no perceptible diminution in size. This is the case even when its mechanical connection with the rest of the body is not entirely destroyed. But surely when loose and separated from the living tissues it must be still less under the influence of the vital actions. In a paper by Mr. Savory, in the *Med.-Chir. Trans.* vol. xlvii., several experiments are described, showing that the absorption of dead bone driven into the living bones of animals, is proportional to the pressure to which it is subjected, a condition which hardly exists in the cases of necrosis that occur in practice.

tained to be loose; but it is not always easy to determine the question whether the bone is loose or not, since the growth of the periosteal sheath, or even the shape of the loose portion, and the arrangement of the parts around it, may prevent it from moving under the probe. In cases, therefore, where the disease has lasted so long that the separation may be reasonably expected to be complete, it is right to endeavour to remove the bone, even although the probe has not given decisive evidence that the operation can be carried out.

I would here call the reader's attention to the extraordinary power which bone, apparently necrosed, has of recovering itself, even after a long period of apparently total suspension of circulation. It is always interesting, and often astonishing, to watch the progress of vascularisation in exposed cranial bone which has long remained white, dry, and to all appearance lifeless. At the present time I have under my care a very young child, in whom an abscess on the scalp had been neglected till the whole affected portion of the scalp sloughed. When admitted into hospital, the child presented in the occipital region two large tracts of exposed bone—one about the size of a penny, the other somewhat smaller, separated by a very narrow bridge of granulations. The bone was white, dry, somewhat rough, and seemed perfectly dead. No treatment of any kind has been adopted, except water-dressing; but now, after about six weeks' residence in the hospital, the edges of skin have grown very considerably over the exposed bone, and the bridge of granulations has extended so as to cover more than half of the smaller piece, while, in almost every part of the bone still left exposed, fresh points of vascularity are showing themselves; and there really seems some prospect of the whole being revivified without any exfoliation.

It is necessary here to say something respecting the agents, and the manner, of regeneration of bone after loss of substance from necrosis. In doing this, however, it would be impossible in an essay of this sort to go into the question with any approach to completeness; but it is hoped that enough will be found in the following paragraphs to illustrate the points necessary for practice. The student who wishes to learn more about the matter is referred to the works of Troja, Wiedmann, Flourens, Syme, and Wagner.

The most important agent in reproducing bone lost by necrosis is, without doubt, the periosteum; and this membrane is sufficient of itself to replace all the ordinary exfoliations and partial necroses which follow injuries, &c. The osteogenic properties of the periosteum, when in contact with the bone, have long been known—in fact, must have been apparent when the function of the membrane was first studied; and that periosteum, when separated from the surface of the bone, will still generate new bone, is no very novel discovery, since John Bell seems to have been perfectly well acquainted with the fact, and describes the formation of a bony cyst by secretion from the detached periosteum, around a collection of blood which had dissected off that membrane from the bone;[1] and the experiments of Syme and Stanley are well known. Lately the osteogenic powers of periosteum have been placed in a very striking light by the experiments of M. Ollier of Lyons.[2] He has shown that, in rabbits, portions of periosteum may be entirely detached from the bone, and pushed into the cellular tissue of the limb, or even grafted into remote parts of the body, or into the body of another rabbit, and that bone would be generated from the fragment of periosteum in this novel position. He has even succeeded in producing bone by such grafting of portions of periosteum kept for more than an hour out of the body.

It is far from certain that any such results could be produced in man, since the conditions of all reproductions, and especially of reproduction of bone, are known to differ so much in man and animals; but, even if the vitality and osteogenic power of the periosteum be less in the human subject than in the lower animals, still it seems

[1] *The Principles of Surgery*, by John Bell; a new edition, by Charles Bell, 1826, vol. iv. p. 406. The author's view of the pathology is sufficiently dubious; but the case may be used to show that Bell knew that bone could be formed from the detached periosteum.

[2] *British Medical Journal*, 1860, pp. 398, 438; *Traité de la Régénération des Os*, Paris, 1867.

reasonable to infer, from observed phenomena, that that power is of the same nature; so that these striking experiments may serve to fix more firmly on the attention of surgeons the importance of preserving the periosteum in cases where the reproduction of lost bones is in question. In all cases, then, where loss of substance in bone has taken place, or where the bone seems deprived of life, it is of the greatest importance that the periosteum should be preserved, a point which will be noticed again in the essay on EXCISION, in speaking of sub-periosteal resection.

The periosteum, however, although the most important, is not the sole agent in the reproduction of bone; so that it may be confidently expected that bone will be reproduced in healthy subjects, even though the periosteum be extensively destroyed; but the reproduction will not be so complete as if that membrane had been left. Such a process of reproduction may often be watched in cases where the soft parts have sloughed after scalp-wounds, and have left the cranium exposed.[1] The accident will often be followed by exfoliation from the surface of the bone; granulations then shoot up from the bony surface so exposed, and these are joined by others which advance from the soft parts in the neighbourhood: a fibrous cicatrix is formed which can be felt gradually hardening and ossifying. If an opportunity occurs for examining it after the lapse of some considerable time (say half a year), it will be found that the fibrous tissue of the cicatrix is ossifying at its deepest part, and scattered granules of bone will probably be met with at various parts of the cicatrix.

This process may go on even when the bone and periosteum have been removed by operation, as in the wounds of resection,[2] but is much more active when previous inflammation has been excited in the medullary tissue, and surrounding soft parts, during the action necessary in order to eject a piece of necrosed bone. In fact, speaking generally, the process of reproduction after necrosis is beyond comparison more active than after injury or operation. Thus, when necrosis has preceded the operation, whole bones of the forearm have been removed, and yet a useful limb has been preserved.

In a case which I had an opportunity of seeing, in which Mr. Savory removed the entire shaft of the radius on account of necrosis, leaving the articular ends,[3] the bone had grown from each of these ends to so great an extent that in eight months after the operation there remained an interval of only an inch and a half, and this appeared to be gradually, though slowly, contracting. This and several similar cases will be found quoted in Wagner's treatise above referred to, and may serve as an encouragement for boldness in our attempts to save limbs after extensive necrosis.

The exfoliation of diseased portions of bone—such, for example, as takes place so frequently in the course of extensive strumous disease, when a portion of the ulcerated surface is cut off from the rest, and therefore perishes—is not generally accompanied by any of that reparative effort which forms part of the process in a more healthy condition. The mere presence of necrosis in such affections is of comparatively little importance; possibly the removal of the dead part may be advisable (but only if it can be done without much violence), but the operation cannot be expected to cure the disease, since the necrosis is not its cause, but its effect. Nevertheless considerable improvement may, in appropriate cases, be expected to follow on the removal of the dead portion, which must always act as an irritant; and the exposure of the carious surface is also very frequently the starting-point of a more healthy action. Hence, when bone is felt exposed and dead, it is usually advisable to endeavour to remove it, even although the surface around it is known to be carious.

The above description applies to necrosis in its more usual form. But, besides this common chronic form of the disease, an affection which deserves the name of *acute necrosis* is sometimes, though not very often, met with. The destruction of all the soft parts surrounding a small bone, as a phalanx in acute neglected whitlow, will of course lead to the exfoliation of the whole of it, and to this affection the name of acute necrosis is sometimes given. There is nothing, however, in the patho-

[1] See Wagner, *On Repair after Resection of Bones* (New Syd. Soc.), Appendix, p. 241, for a case in which this form of reproduction is well described.

[2] See Wagner, *op. cit.* p. 156.

[3] Ibid. p. 243.

logy or treatment of such a disease to call special attention to the bone. The rapid and tensive inflammation threatens other parts of equal importance—the joint, the tendons, nay, in some cases even the skin—with destruction; and the free evacuation of the products of the inflammation is the only measure from which any good can rationally be expected. But there is a less known class of cases in which larger bones are involved in rapid destruction, without known cause, or from causes apparently quite inadequate; and such cases involve not merely local mischief, but very grave danger to life. Many such cases of rapid necrosis are the result of that diffuse inflammation of the periosteum, or medullary tissue, which has been described above; but in others which I have had an opportunity of seeing, I have failed to detect such a cause for the death of the bone, or indeed any cause to which so extensive and so universal an action could reasonably be ascribed.

Such a case was the following. A stableman was admitted into St. George's Hospital on account of disease in one foot. The history was obscure, but it seemed certain that little more than three weeks before his death the foot was comparatively well, as it was to an injury supposed to have been received two days before his admission, in running violently down the stable-yard, that the disease was attributed. There was œdema, swelling, and pain over the dorsum of the foot; and this condition was attributed to diffuse cellular inflammation, and treated by superficial incisions, which did not penetrate the periosteum. The man died, with symptoms of pyæmia, but no secondary abscess, twenty days after his admission. On examining the foot, all the tarsal bones were found loose, and grating on each other like stones in a bag; the cartilages between them had almost entirely disappeared. On section, the bones were of a dark-grey hue, and some slight trace of pus was seen here and there in the interior, but no such distinct indication of inflammation of the lining membrane of the cancelli as to deserve the name of osteo-myelitis; nor was the periosteum thickened, vascular, or separated from the surface of the bone by either lymph or pus in any appreciable quantity. The surfaces of the bones exposed by the removal of the articular cartilages were ulcerated, but not deeply. The bones were of their natural consistence.

Is such an affection as this amenable to any treatment? This seems doubtful, if it be conceded that cases of acute necrosis really exist in which the affection is different from diffuse periostitis. In the latter affection timely incisions may succeed, as has been already said, in checking the effusion and restoring the nutrition of the bone; but if the whole bony tissue be involved at once, what agency can be reasonably expected to restore it to health? It is clear that the main question in such a case is, whether the patient's powers will endure the strain of the disease, so that the bone may be cast off, and he may have the chance of its reproduction, or whether amputation will give him a better prospect of life. But the prognosis of an amputation undertaken under such circumstances would be in the highest degree unfavourable, since the condition of system in which such grave results can follow from such trivial injuries leaves little prospect of bearing up against so serious an injury as the removal of a limb; and the tendency to pyæmia is so strong that it is impossible to say that that condition of the system may not be actually present, though latent, when the operation is done. It will therefore, in most cases, be judged better to support the patient's strength by a liberal allowance of tonics and opiates until the graver dangers have passed away; and then, if the usefulness of the limb is hopelessly destroyed, to remove it when the patient has rallied from the typhoid condition in which the disease commences. Incisions may not have the power of averting the death of the bone, but they ought to be made to an extent sufficient to liberate all tension, and that for two principal reasons—partly in order to avoid sloughing of the periosteum, and consequent destruction of the nidus in which the new bone is to be formed, partly to provide drainage and a ready way for the pus, which must form, to escape, and partly for the examination of the bone and for its eventual extraction.

Acute necrosis, whether resulting from diffuse periostitis or not, may be treated by the extirpation of the whole bone so affected, a very free incision being made through the periosteum, which will be found completely separated from the bone, and the bone being, if necessary, divided by a chain-saw passed underneath it. In cases of necrosis of the entire diaphysis of a long bone, a slight twist with the lion-forceps will detach the dead portions from the epiphysial lines above and below.

In this way I removed successfully the whole shaft of the tibia (seven and a half inches long), at the age of ten, one month after the commencement of acute periostitis, with very successful results.[1] I think, when we have clear reasons for believing that the necrosed bone will be found loose, its early removal is most desirable, and liberates the patient from great dangers, both in the present, from the acute surgical fever kept up by the irritation of the diseased bone, and in the future, from the risks incident on the numerous and severe surgical operations which will probably be necessary for the removal of so extensive a sequestrum. I do not recommend the operation when a portion only of the diaphysis has perished, and has not yet separated. The old idea that it is necessary to wait in these cases for the formation of a periosteal sheath of bone, is sufficiently refuted by my cases and that of Mr. Joseph Bell, which show that even in so large a bone as the femur a great portion (and I do not see why not the whole, if such a case should occur) of the entire circumference of the shaft may be removed, and the limb be left perfectly flail-like after the operation, and yet entire consolidation and perfect usefulness of the limb may finally result.[2]

Constitutional Affections.

Scrofula in bone.—There are two forms in which scofulous affections of bone are met with : viz. either a deposit of tubercle, or a low inflammation of the osseous substance ; and there is good reason for considering the former as a consequence, or effect, of the latter. Let us, then, first consider the peculiar or distinctive characters of scrofulous inflammation of bone.

A scrofulous bone, when examined in the early stage of the disease, is soft, light, and oily ; sometimes more highly charged with blood than natural, and occasionally (though only rarely) presenting a deposit of tubercle in its interior. Bones in this condition are constantly met with after the removal of scrofulous joints : the substance of the bone is easily cut with a knife, and the cancelli are large, and charged with a red jelly-like mass of débris. The inflammation readily passes into ulceration, or caries, and the bone then exhibits on its surface a number of minute pits or depressions, from each of which the ulceration extends, so as to communicate with those around, until an extensive worm-eaten surface is exposed,[3] soft and rotten on its exterior, bleeding readily, and giving exit to a foul-smelling ichorous pus, in which pieces of decomposed bone can be felt as gritty particles under the fingers. The periosteum becomes detached and thickened, and is gradually converted into a gelatinous mass of granulations.

The minute changes in the ultimate tissue have been ably described by Dr. Black, in a series of researches to which my own observations lead me to assent. The cancelli are dilated, and they, as well as the lacunæ and canaliculi, are filled with exudation. Occasionally, minute projections of bone from the walls of the cancelli indicate an attempt at the reproduction of bone, and that healing by sclerosis which has been already described as one of the usual events of healthy inflammation. The leading features, then, of the pathological anatomy of strumous inflammation are the same as those of ostitis in general ; and the only distinctive anatomical peculiarity consists in the nature of the exudation, which chokes up the canals of the bone. Dr. Black has given several analyses, tending to establish these four conclusions : that tuberculosis gives rise (1) to a considerable increase of fat in the diseased bone ; (2) to a large diminution of the salts of lime ; (3) to a diminution of the organic matrix ; (4) to an increase in the soluble salts. For the details

[1] *Lancet*, 1866, vol. i. p. 340. See also *Surgical Treatment of Children's Diseases*, 2nd edit. p. 391, *et seq.* ; *St. George's Hospital Reports*, vol. x. p. 500 ; where other instances under my own care are related ; also a case by Mr. Joseph Bell, *Brit. Med. Journal*, May 2, 1868, very similar to a case of mine in the femur, but more extensive. Many other cases have since been operated on ; indeed the operation has now become a recognised one.

[2] An interesting example of the entire regeneration of the clavicle after its extirpation will be found in the New Syd. Soc.'s *Biennial Retrospect*, 1867–8, p. 262.

[3] For the appearance of scrofulous ulceration in the macerated bone as contrasted with simple ulceration, see figs. 47A, 48, p. 289.

of the analysis, the reader must be referred to the original treatise.[1] They serve to illustrate the fact, that strumous is distinguished from common inflammation by the softness, lightness, and oiliness of the affected bone; to which may be added, the greater extent of diffusion of the morbid changes.

The superficial caries, during the mere presence of which, the bone, if the affection be not very extensive, is possibly still in a curable state, spreads gradually inwards, and then the condition of the bone passes beyond the possibility of repair. Large abscesses form, and the whole cancellous extremity, or the whole bone, if it be one of the cuboid bones of the tarsus or carpus, is converted into a cavity bounded by a thin shell of osseous matter, and containing bony substance, either in mere débris, or so soft that it will crumble away in maceration. These abscesses are seldom accompanied by that thickening of their walls from periosteal deposit which takes place in simple ostitis; still, at some distance from the seat of profuse suppuration, fresh deposit is sometimes found thickening the bone, or producing anchylosis in the less movable joints. Necrosed portions of larger or smaller size are often found, but no 'sequestra' in the proper sense of that term, as signifying necrosed portions invaginated by new bone.

Such are the anatomical characters of scrofulous inflammation of bone. The other common development of that diathesis in the osseous system consists in the deposit of tubercle either circumscribed or diffused. Circumscribed tubercle[2] (much the rarer form) seems most common in the skull, deposited on the outside of the bone beneath the periosteum (the strumous node); and next to this its favourite locality is in the cancelli of the joint-end of some bone, generally the tibia. No inconvenience seems to be produced by such tubercle till it softens; and then, if situated in the articular end of a bone, it usually makes a passage into the neighbouring joint and destroys it; if on the skull, the softening of such a tubercle forms a cachectic abscess difficult to heal, bordered by indurated cellular tissue, with cold, bluish edges, and leading to exposed and roughened bone, which, however, has not the peculiar feeling of necrosis, and is not at first dead, although it is liable to become so. The deposit of diffused tubercle is more common in the shafts of the long bones. It fills up the cancelli, appearing as a nodulated, or granular, yellowish

[1] *On the Pathology of Tuberculous Bone*, p. 32. Edinb. 1859.

[2] Tubercle in bone is, in any view of the case, rare. Rokitansky's statistics give a low place to the bony system as a seat of tubercle; though they place the bones and periosteum considerably above the testicle and epididymis, which is hardly in consonance, I believe, with the experience of most surgeons. But the nature of the deposit generally spoken of as tubercular is the subject of much difference of opinion among different pathologists. Dr. Wilson Fox says: 'These limitations of tubercle have proceeded so far, that, if the exclusion of the different forms from the category of tubercle, proposed by various pathologists, were simultaneously carried out, tubercle would—not unfortunately, cease to exist—but would certainly have no longer any place in our nosologies; for nearly every pathological product hitherto ranked under this title, from the grey granulation to the yellow granulation and the cheesy infiltration, is by some authority or other excluded from the category of tubercle.'—*Artificial Production of Tubercle*, p. 22. My opinion is, that many of the deposits which are usually regarded as tubercles in bone, are masses of inspissated pus mingled with other inflammatory products; and that, rare as tubercle in bone is generally said to be, it is in reality still rarer. Mr. Macnamara, on the other hand, for whose opinion I have a sincere respect, believes that the deposit of inflammatory material found in the bones of tuberculous subjects differs in no respect from the deposits of tubercle which may be found in their viscera, and looks upon tubercle in bone as a tolerably common appearance. See the Fourth and Fifth of his recently published Lectures on Diseases of Bones and Joints. Some of the German pathologists appear to regard every inflammatory production in which 'giant-cells' and 'a reticulum' can be found as tuberculous, and then go on to assume for this tubercular product an auto-infecting property. All this however appears to me to rest on the slenderest basis of fact (see Treves on Scrofula, ch. iii. and iv.) Mr. Croft, in relating some cases classed by him as tubercular affections of the articular ends and synovial membranes of joints, in *Path. Trans.* vol. xxxii., has with the caution of experience allowed that we want much more extended information. Much of the present difference of opinion, however, depends on the view taken of the nature of tubercle. The Germans for the most part regard it as a specific, and infecting new growth; the English, generally, as the outcome of chronic inflammation under certain constitutional conditions. See Mr. Treves's essay on Scrofula, in vol. i.

mass of soft consistence, and extends frequently along the whole length of the shaft. My own impression is that this diffused tubercle less frequently and less rapidly softens than the circumscribed; but exact information on this point is wanting. It should be remembered that when the shaft is attacked by this or any other form of disease, the extremities usually escape, and *vice versâ*—a matter of great importance in the treatment of diseases of the joints.

It has occurred to me, though hitherto only on two occasions, to meet with a particular form of ulceration, which was in one case certainly,[1] and in the other probably, connected with scrofula.

Numerous pits were found on the articular surface, varying in depth, but confined to the epiphysis, with sharp edges, and curdy purulent contents. Their openings into the cavity of the joint were clearly punched out of the cartilage, and all the cartilage around was quite healthy. A few small granules of bone were met with among the contents of the cavities. In one of the cases, when the bones were examined, there were found several spots of vascular and softened tissue beneath the surface of the bones, evidently the commencement of similar pits. There was no trace of tubercle. The thigh was amputated, and the patient recovered for a time, but soon died of phthisis. In the other case, the patient, a boy under the care of Mr. Thomas Smith, recovered after excision of the knee, and remained long afterwards in good health.[2]

I believe this pitting or spotted ulceration of the articular ends of bones to be one of the forms of scrofulous disease, and to be indistinguishable from its other forms before dissection. It presents a very favourable condition for resection, from the strict limitation of the disease to a very slight depth below the surface.

Symptoms.—Of the symptoms of scrofula in bone little need be said here. The general symptoms of the diathesis, added to an indolent swelling of some bone, lead to a diagnosis not to be mistaken. The swelling is composed partly of the engorged soft tissues, and partly occasioned by real enlargement of the bone. The colour is usually white and pasty,[3] and the swelling indolent; but sometimes, when the inflammation is higher than common, and suppuration imminent, redness and pain may be present. When suppuration has been effected, the pain generally subsides, and the functions of the part are more or less completely regained, even when the bone is destroyed to a considerable extent.

Treatment.—The treatment of scrofula in bone offers little that is peculiar. For local treatment perhaps the most important indication is to keep the part at rest by splints and bandages during the prevalence of inflammation. Local depletion should be cautiously used while there is pain, tenderness, and superficial redness, or the part may be enveloped in a large warm poultice or fomentation. When inflammation is not apparent in the soft parts, but there are signs of its presence in the bone, it will be necessary to use counter-irritation by a light application of the actual cautery by blisters or by caustic issues; or in less severe and more chronic cases by means of the tincture of iodine, or other stimulating application. When irritation has subsided, pressure by means of strapping will be found very serviceable, both in ensuring rest and promoting absorption, and the local application of mercury (Scott's bandage) may be combined with this. By these simple measures, with judicious constitutional treatment, most of the cases of strumous inflammation, which are seen before the occurrence of suppuration, will be brought to a favourable issue.

When the suppuration is once established, it is better to procure exit for it by small incisions, and to use every precaution to prevent the denudation of fresh portions of bone. The question, however, of the early or late opening of abscesses connected with strumous bone is one on which a good deal of difference of opinion very naturally exists, and which is best determined in each individual case. If, however, the abscess be near an important organ, as a joint or serous cavity, then

[1] A notice of this case will be found in *Path. Soc. Trans.* vol. x. p. 217.

[2] This is figured in the work, above referred to, *On the Surgical Treatment of Children's Diseases*, p. 488.

[3] The 'white swelling' of old authors was named from strumous disease of the joints, though many other affections came to be included under the term.

undoubtedly no time should be lost in evacuating it. The use of Lister's method has seemed to me extremely advantageous in these cases. When the bone is exposed through the opening of an abscess, its condition should be thoroughly investigated, once for all, with the probe, in order to judge of the necessity for operative interference; but nothing is more mischievous than repeated meddling with diseased bone. The general indications for operations upon bones affected with strumous caries, and the form of operation indicated, will be the same as in caries depending upon other causes; but the prognosis will be less favourable than when the constitution is unaffected, and therefore operations should be undertaken with more caution. Operations on these cases will usually succeed or fail according as scrofula has attacked the viscera or no, and according to the extent of its diffusion through the system; but even after a successful operation the patient is by no means secure against a relapse in some other part. It has lately become common to perforate bones affected with scrofula either by means of a small trephine or a drill, and to keep the canal so made constantly drained, the whole proceeding being performed with antiseptic precautions. If a neighbouring joint is affected, it should be freely opened at the same time and drained. I would refer to Mr. Macnamara's work, p. 115, for instances of the success of this practice.

For the general treatment the reader must be referred to the essay on SCROFULA.

Closely allied to tuberculosis is the affection designated Lymphadenoma, or Hodgkin's disease; and although little is known of the affection of the bones in this disease, yet Mr. Macnamara (*op. cit.* p. 123) has recorded a case of lymphadenoma in which an extensive deposit of lymphoid or fibrocellular material was found in the cancellous tissue of the tibia, very similar to that which existed in the cervical glands. No mention is made of any symptoms connected with this condition of the bone, nor is it stated that any other bones were examined. The case, however, is interesting as calling attention to another of the widespread influences of this destructive affection.

Syphilitic affections of bone.—The chief phenomena of the syphilitic affections of bone are described in the essay on SYPHILIS; it will therefore only be necessary here to go a little more into detail as to the anatomy of bone affected by syphilis, and the means by which the disease is to be diagnosed. As the general treatment of syphilis is laid down in Mr. Lee's essay, only the local treatment of its manifestations in the osseous system will be dwelt on here.

Syphilitic affections are those in which the existence of a chronic limited inflammation of the periosteum alone is most clearly proved, if indeed such inflammation be not peculiar to syphilis. Strumous nodes (as we have just remarked, p. 304) are formed by scrofulous matter confined between the carious bone and its periosteum, and are due to an affection of the bone; but the true node, that which follows syphilis, is caused by the effusion of lymph between the bone and the periosteum, and is due to inflammation of a limited portion of the deep layers ('sub-periosteal blastema') of the latter. Hence it is of a different signification from that of a strumous abscess; for, while the latter is merely a consequence of diseased bone, and necessarily involves corresponding loss of substance and the slow processes by which alone an ulcer (and more especially a strumous ulcer) in bone can be healed, the syphilitic node is itself the starting-point of the disease in the bone, and if early and properly treated, the whole organ can be restored in a short time to a state of health. But, although in a node the inflammation is usually limited to the periosteum, it is not always so. Numerous preparations show thickening of the substance of the bone beneath nodes,[1] proving the implication of the deeper structures, and therefore a state of disease which, though still curable, may be expected to be more obstinate than mere periosteal effusion; and if the skull be examined in the situation of a node, some roughening of its outer table may generally, perhaps

[1] St. Thomas's Hospital Museum, series c. No. 54.

always, be discovered. The progress of nodes, when they are not absorbed under appropriate treatment, is in one of two directions; either the subperiosteal effusion ossifies, or it softens and gives rise to caries, accompanied usually by suppuration. The former event is commoner on the tibia, the latter on the skull. The indisposition of the pericranium to form new bone is a well-known fact in pathology, nor am I aware that the formation of new bone in syphilitic nodes of the skull has ever been proved, though new bone may be sometimes found deposited on the outer table of the skull in the neighbourhood of large ulcers;[1] in nodes of other flat bones also, ossification, if it occurs, is rare. Many nodes appear so hard as to be pronounced osseous; but the feeling is often deceptive, since the tense and thickened periosteum raised by semi-solid effusion gives a sensation hardly to be distinguished from that of a bony swelling. Therefore, in a hard node which is of no long standing, treatment for its removal may be confidently recommended, and all the more if the swelling be situated on a flat bone. On the tibiæ nodes are prone to ossify, and then the deeper ossified part remains as a permanent irregularity on the surface of the bone; but the unossified portion may often be dispersed by appropriate measures. When a node softens, and the question occurs whether pus has formed, the case ought to be carefully examined, in order if possible to determine the point. The principal indication of the presence of pus is the shining, tense, and thinned condition of the skin. It is important to obviate more destruction of the skin than is inevitable on the bursting of the abscess, since such sores are very difficult to heal, and in some cases appear incurable. The best way is to make a very small puncture, and close it after drawing off the pus. Frequently, under the proper treatment, the soft parts will adhere again to the bone with very slight or no[2] exfoliation. It is especially in these cases of abscesses communicating with the surface of a bone that I have found the treatment by carbolic acid, recommended by Mr. Lister, most successful. In several cases under my own care where I have had either positive proof or the strongest reasons for concluding that the abscess was connected with diseased bone, I have found the abscess heal readily and without exfoliation. Many others have also been put on record by Mr. Lister and other surgeons. Very commonly, however, the formation of periosteal abscess after a node is followed by the exfoliation of most of the subjacent bone. Syphilitic nodes are usually preceded, and always accompanied, by more or less of dull aching pain in the bone, especially liable to exacerbations at night; or this 'syphilitic rheumatism,' as it is sometimes called (the *douleurs ostéocopes* of French authors), may be the only symptom referred to the osseous system during the progress of the secondary affection.

When the syphilitic cachexia is further advanced, the whole bone or a great part of it may be diseased through its entire thickness, leading to chronic ostitis, and terminating in sclerosis, or what is sometimes called 'hypertrophy' of the whole thickness of the bone. I am not aware of any distinction which could be drawn between such instances of chronic inflammation and those arising from non-specific causes, except that which is founded on the presence of concomitant and preceding syphilitic symptoms in other organs.

Still more grave and more obstinate developments of tertiary syphilis in the bones are those carious and necrotic affections (ulcerative or gangrenous) which so often attack the skull, the bones of the face, and the superficial long bones, in persons much reduced by excesses, or by the injudicious administration of mercury. In former times, under the horrible system which prevailed in the 'foul wards' of the great hospitals, where every person labouring under any disease supposed to be caused by promiscuous intercourse was compelled to take mercury to salivation, the ravages of syphilis on the bones were dreadful; and it is to this system that we owe

[1] Even here it is in most cases doubtful whether the deposit has been formed outside the skull, or whether the thickening is not produced by deposit within the diploë expanding the outer table; for deposit in the diploë is exceedingly common. See below on the 'tuberculated' form of syphilitic ulceration in bone.

[2] See Parker, *Modern Treatment of Syphilitic Diseases*, 4th ed. 1860, p. 291.

many of the preparations of syphilitic caries and necrosis preserved in our museums But there seems no reasonable doubt that such affections do also occur in persons who have never taken mercury,[1] especially when the disease has been allowed to go on unchecked, and the constitution is at the same time enfeebled by alternations of debauchery and hardship, as is the case sometimes with sailors, and more frequently with prostitutes.

The diagnosis of syphilitic affections is usually easy from the history of infection and the presence of other symptoms; but it may in some cases be obscured by the patient's unwillingness or inability to reveal the history of the original disease. Thus the pains in the bones may be referred to rheumatism; but here the diagnosis can in most cases be easily established by observing that rheumatic pains in the bones are generally accompanied by affections of the thick fibrous structures (muscles or fasciæ) and of the joints; or, if the rheumatic affection be more acute, the urine and sweat will probably furnish indications of the nature of the disease. When nodes have made their appearance, the diagnosis is usually easy, the only question

Fig. 50.—Syphilitic Ulceration of the Annular variety. (Museum of the Royal College of Surgeons, No. 635.)

lying between syphilis and struma, since rheumatic periostitis is, as we shall see, more diffused. In the absence of history, the concomitant symptoms will guide us while the skin is unbroken; and after pus has made its way to the surface, some assistance may be derived from the nature of the secretion. Syphilitic caries and necrosis (as is observed in the essay on Syphilis) are not primary affections of the bones, but are the result and termination of nodes, or of inflammation of the bones, or of ulcerative affections of the soft parts around the bone, as in the palate, and therefore have been preceded by a long course of symptoms, during which the diagnosis is usually established. If not, it rarely presents any difficulty, since the traces or the presence of other symptoms of constitutional syphilis can hardly fail to be recognised.

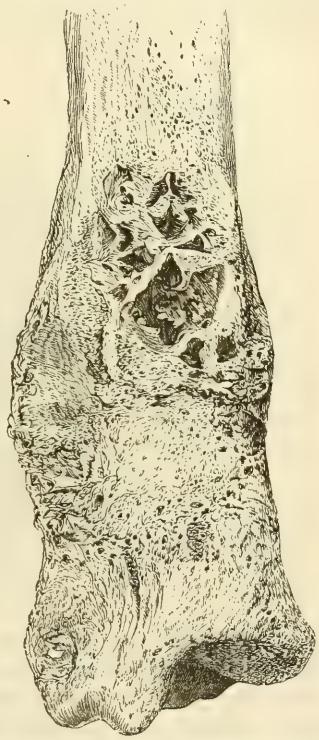
An interesting comparison has been made between the forms of syphilitic ulceration in bone and those of syphilitic eruption on the skin. Specimens of rounded ulcers may sometimes be met with, especially on the skull-cap, which bear a strong resemblance to the rupial ulcers so frequent in an advanced stage of constitutional

[1] See Parker, *op. cit.* p. 281.

syphilis. A small round spot of ulceration is seen, where the surface of the bone is worm-eaten from the presence of numerous minute depressions, and in some cases the bone around this worm-eaten central portion is marked by arborescent grooves, the traces of increased vascularity. Later on, a circular trench is marked around the worm-eaten spot; and as this widens and deepens, it undermines and finally chisels out the piece, which separates as a sequestrum, and then the bone scars over, leaving a rounded depression, much larger than the original spot, the surface of which is rather glazed and a little vascular, and the bone below it a good deal hardened. In well-marked specimens, these *annular* ulcers, as they are termed by Sir J. Paget, fig. 50, look very characteristic, but in less advanced cases, especially before the surrounding trench has formed, or again at a late period when cicatrisation has obliterated some of the more distinctive characters of the ulcer, it seems

Fig. 51.—Syphilitic Ulceration of the Tuberculated variety. (Museum of the Royal College of Surgeons, No. 632.)

Fig. 52.—Syphilitic Ulceration of the Reticulated variety. (Museum of the Royal College of Surgeons, No. 630.)



impossible to distinguish it from a scrofulous or other lesion. The other characteristic form of syphilitic ulceration is the *tuberculated*, fig. 51, which appears to commence by a tubercular thickening of the external wall of the bone, recalling the syphilitic tubercle so common on the skin of the face, &c., and due not to periosteal deposit, but to chronic inflammation of the compact tissue itself. This inflamed bone soon becomes dotted over with numerous little pits or depressions, which coalesce and form ulcers, usually oval or round, penetrating deeply into the interior of the bone. Besides these, Sir J. Paget has described a third form of syphilitic ulceration, the *reticulated* (fig. 52) in which the disease appears first to show itself in the form of a network of periosteal deposit, which is liable to perforation by ulcers subsequently forming and assuming the annular type, of which latter, therefore, the above may be regarded as a variety. Of the two kinds of syphilitic ulcer, the annular appears to me the more characteristic; but I do not believe that either is so distinctive of the disease as to enable us, with anything like certainty, to infer the previous

constitutional affection from examination of the affected bone; nay, I have known pathologists of the greatest experience refuted in such attempts by the subsequent discovery of the history of the preparation.

The accompanying figures represent characteristic examples of these various forms of syphilitic ulcer; and by comparing them with those of simple, strumous, rheumatic and malignant ulceration, which will be found at pp. 289, 312, 321, the reader will be enabled to see at a glance, much better than by verbal description, the differences of these affections as shown on the macerated bone.

Any of these forms of syphilic ulceration may affect the bone so deeply as to penetrate its whole thickness. Thus in the Museum of St. Bartholomew's Hospital is a specimen (A 34) of a clavicle in which the bone has given way (probably after death) in consequence of penetrating ulceration attributed to syphilis. Spontaneous fracture of a long bone, however, from penetration by a syphilitic ulcer is extremely rare; while penetration of a flat bone, especially of the cranium, is still a pretty frequent circumstance, and used to be an ordinary result of syphilis. In the greater

Fig. 53.—Penetrating Syphilitic Ulcer. (Museum of the Royal College of Surgeons, No. 636.)

number of such cases no serious mischief follows; the dura mater is exposed on the separation of the necrosed central part of the ulcer, but soon gets covered over, so that its pulsations are no longer visible, and in a little while the gap will be filled up by fibrous tissue. In rare cases, however, pressure upon the brain is produced either by matter confined between the skull and dura mater, or by ulceration laying open a branch of the middle meningeal artery and causing hæmorrhage.

Treatment.—The treatment of constitutional syphilis has been already described, and it has been shown that at one period or other of the disease a prolonged and sufficient exhibition of mercury will be necessary for a cure. To this general rule the affections of bone form no exception, for although some of them are usually found accompanied by so profound a cachexia, so complete a prostration of the whole system, that mercury is inadmissible, it will also be found that such affections do not admit of cure. Iodide of potassium often acts, however, upon the earlier affections of the bone and periosteum like a charm, and the symptoms soon disappear; but those whose experience in the treatment of syphilis is most extensive [1] believe that the improvement is not permanent, and that for the entire eradication of the constitutional affection a mild but prolonged course of mercury (for which the calomel

[1] See the essay on Syphilis, and Parker, *op. cit.* p. 289.

vapour-bath is the most appropriate agent) ought to be insisted on. The local treatment of bone inflamed from syphilis presents several interesting questions. Nodes will usually be benefitted by blisters, or if the bone seem to be more deeply affected, by the persevering use of mercurial ointment, strapping with the empl. hydr. cum ammoniaco, iodine paint, &c. But when the pain in the inflamed bone is constant and very distressing, it is quite justifiable to divide the periosteum by a free incision; and then, if nothing is found to account for the tension and to hold out a prospect of its relief, a trephine may be applied to the bone itself, and its medullary canal laid open.[1] If symptoms of cerebral disturbance make their appearance in the course of ulceration of the cranium, the application of the trephine has sometimes been successful in preserving life; but, on the other hand, it is not to be denied that it has sometimes produced or hastened death. The proverbial obscurity of all cranial affections ought, I think, to make us cautious in adopting so extreme a measure as trephining the skull, unless in a patient whose state is otherwise evidently hopeless. Epileptic convulsions, even with slight symptoms of paralysis, are hardly a sufficient indication for the operation; but the experience of Mr. H. Lee[2] has shown that in some cases the removal of the diseased bone has been followed by the healing of ulcers which had previously been obstinate; and it seems that the removal of the outer table only, when it is dead, and appears to be keeping up irritation, is a safe practice.

The treatment of fissures and defects of the palate from syphilitic necrosis will be found discussed in the essay on Diseases of the Mouth.

Rheumatic affections of bone.—It is extremely difficult to be certain of the existence of any specific affection of bone due to the rheumatic diathesis.[3]

I would not be understood, however, to deny the existence of an affection which deserves to be called 'rheumatic ostitis.' The condition of the articulating extremities of the bones in cases of osteo-arthritis is very peculiar, and can hardly be explained by any theory except that of some constitutional peculiarity in the disease, since neither the age of the patient nor the mode of causation of the malady offers any constant features which can account for the singularity of the affection of the bone. That which is most characteristic in all those cases which appear to be rheumatic, is their very slow course, and the great length of time during which inflammation may be present without either caries or necrosis.

The chief features which are distinctive of rheumatic inflammation of the bones are, the extensive deposit of bone in the fibrous structures around, the condensation and thinning of the shell of the bone, the rarefaction and partial absorption of its interior, and the consequent change of shape which parts containing much cancellous tissue, such as the articular heads and necks of long bones, suffer. In the articular disease the new bone is found, to a great extent, in the ligaments and other tissues distinct from the periosteum, and thus forms what Dr. Adams calls 'additamentary bones,' which have been so often mistaken for portions fractured off the bony prominences, near which they may be situated, and remaining ununited. I shall adduce some reasons for believing that many of the specimens in which portions of bone have been found near the shafts of long bones, but movable upon them, and which have been thought to be instances in which exostoses had been fractured at their base, may be of the same nature.

In the Museum of the Royal College of Surgeons, Sir J. Paget has classed some specimens[4] as 'rheumatic ulceration,' in which, along with these appearances on the shaft of the bone, ulceration is seen invading the newly-formed periosteal deposit. One of these preparations will be found represented in fig. 54. In any case, the occurrence of nodes, and more or less of inflammation of the wall of superficial bones

[1] Parker, *op. cit.* p. 283. [2] *Proceedings of the Med.-Chir. Soc.* vol. iii. p. 283.

[3] The disease now commonly called 'chronic rheumatic arthritis' or 'osteo-arthritis' is regarded by some authors of credit as originally a disease of the bone. It is described in the essay on Diseases of the Joints.

[4] Nos. 626, 627, 627a.

in cases of rheumatism, is a sufficiently probable event; but it is a complication which must be treated on general principles. The nodes do not affect the limited extent and rounded outline of those due to syphilis, but are irregular swellings of the periosteum, involving a considerable extent of the surface, and probably some of the thickness of the bone.

Fig. 54.—Rheumatic Ulceration of Bone. (Museum of the Royal College of Surgeons, No. 627.)

As to the treatment of the rheumatic affections of bone, nothing need be said here, since all that is necessary to add to the general treatment of ostitis will be found in the essay on Diseases of the Joints, to which essay I must also refer for the affection of the articular ends of the bones, which has been described by Charcot as occurring in the course of locomotor ataxy.

Mollities ossium.—The peculiar condition of the bones which is known by the name of mollities ossium, or malacosteon, is one which is very rarely met with. In the female pelvis, as a cause of difficulty in parturition, it is less rare than under other circumstances, and demands the special attention of the obstetric surgeon; but in this place we have only to consider the disease in its pathology and general surgical bearings.

The pathology of mollities is far from being satisfactorily established; and there can be little doubt that this has arisen, in great part at any rate, from the fact that authors have confounded several different conditions under the same name. Some, indeed, make no distinction between mollities and fragilitas ossium; while others regard mollities as an affection allied to, if not identical with, rickets.

The disease which appears best to deserve a separate description under the name of mollities is marked by the following characteristics. Several bones are usually affected at the same time. The portions of bone attacked are uniformly softened throughout. The disease, however, does not in all cases attack either the whole length or the whole thickness of the bone; and, if the specimen be examined at an early period, the outer shell is often found to retain its natural consistence.[1] When the whole bone is affected, it can be readily bent, and resembles, in extreme cases, as Dr. Ormerod[2] remarks, rather a portion of fatty matter enclosed in a case of periosteum than a bone. If the cancellous tissue (in which the disease appears to originate) be examined, it is found that the cells are enlarged, sometimes to such an extent that the whole bone is expanded, and are filled with a peculiar reddish gelatiniform matter, in which, on microscopical examination, much fat and oil can be discovered, together with blood-discs. Besides these (which are the common products of any degenerative change), certain peculiar nucleolated nuclear bodies have been described by Mr. Dalrymple.[3] Instances of bones affected with mollities do, however, occur, in which the amount of fat is not greatly increased. Thus in a specimen in Guy's Hospital Museum (No. 1004[88]), taken from a case reported by Mr. Solly in the 'Med.-Chir. Trans.,' vol. xxvii., it is said that the diseased tissue consisted simply of an organic matrix, with little earthy matter, and containing little fat. Cases like these show that it is impossible to describe mollities as simply

[1] As in Dalrymple's case, referred to below.

[2] *Brit. Med. Journal*, Sept. 10, 1859.

[3] *Dublin Quarterly Journal*, 1846, p. 85; see also *Path. Soc. Trans.* 1846–7, p. 148, and Durham, in *Guy's Hospital Reports*, 3rd ser. vol. x. It is said that in bones affected with mollities, lactic acid and lactates are to be discovered, and that this lactic acid promotes the solution and absorption of the phosphate of lime. The fact, however, appears doubtful. See Drivon, *Arch. gén. de Méd.* 1867, vol. x. p. 608.

a fatty degeneration. Degeneration of some sort is, however, always present; and, as this advances, it involves the compact walls of the bone, and then the disease becomes for the first time recognisable by the symptoms which will be immediately described. At a later period the whole bone is found to be involved, and becomes a mere bag of soft matter enclosed in the periosteum—which, perhaps, may be somewhat thickened—but it does not appear that any further destruction of the bone itself occurs. It is merely converted into a soft, generally oily, material, which crumbles away on maceration, but which seems capable of resisting absorption for an unlimited period during life.

The symptoms of mollities are sufficiently striking in a well-marked case to attract immediate notice, however obscure may be the real nature of the constitutional affection. The patients are usually women, and repeated pregnancy appears to act as an exciting cause of the disease, and to account for the greater proportion of females.[1]

The disease appears to be, in some cases at least, hereditary. Thus, in the history of Dr. Ormerod's patient, referred to above, it is stated that both the son and daughter were subjects of the same affection. Sometimes pain is complained of in the affected bones for some time before the nature of the disease becomes manifest; in other cases, however, the deformity induced by gradual softening of the bones is the first symptom noticed. When this softening has proceeded far enough, the bone gives way gradually, if it has been equably and thoroughly softened, so as to yield, and become merely deformed; but if the softening has been confined to the internal part of the bone, and the thin outer shell has been left solid, and therefore brittle, spontaneous fracture (or, more correctly speaking, fracture from very slight causes) is liable to occur. In extreme cases of mollities the limbs become distorted in the strangest way, so that the thighs have been known to bend till one of the feet touched the head; and, from the softening of the vertebral column and bending of the limbs, the stature is very considerably diminished. The constitutional cachexia is often not very strongly marked, and patients will live in this condition for an indefinite period, bedridden from the weakness of their limbs and the loss of the firm points from and to which the muscles act, but with sufficient mental and constitutional vigour. The cause of death appears generally to be simple exhaustion, or failure of vital powers, like what takes place in extreme old age (in fact, some of these patients do not die till the extreme of life), or sometimes functional disturbance, induced by the altered relations of the viscera, and the pressure to which, from various causes, they are subjected. Not unfrequently, however, the patient does not die of the disease at all, but, having lived under its influence for many years, is carried off by some totally different complaint.

It seems indubitable that in some cases recovery takes place. Out of the 145 cases referred to in Mr. Durham's paper, it is said that 'obvious improvement or cure is stated to have occurred in twenty-two;' in eighteen of which, however, the origin of the disease is clearly stated to have been associated with pregnancy or with the puerperal condition; and the pelvic bones alone, or these and the lower part of the spine only, were affected.[2] No doubt in such partial cases (and especially when the disease is referable to frequent pregnancy) the prognosis is better; and I am not inclined absolutely to dissent from Mr. Durham's opinion that no case is to be looked

[1] In Mr. Durham's paper reference is made to 145 cases. Of these only 13 were males and 132 females; and of the latter 91 were first affected during pregnancy or very shortly after childbirth. Mr. Durham's figures would lead to the conclusion that the disease usually commences between 25 and 35 years of age. This no doubt depends on the large number of parturient woman included in his table. In cases not connected with pregnancy, the disease usually, I believe, begins in advanced life. Dr. Rehn of Frankfort exhibited to the International Medical Congress a well-marked specimen of mollities (clearly not rickets) in a child under two years of age. (Trans. of International Congress, 1881, *Diseases of Children*, p. 59.)

[2] The most remarkable case of recovery is one of those recorded by Beylard, *Du Rachitis, &c.*, pp. 266–74, in which the person affected managed by gradual extension to increase her stature by half a metre, *i.e.* more than eighteen inches, from what it was at the period of the greatest curvature of the spine. The duration of the case had been at that time about twenty years, and the patient was in good health, though deformed.

on as entirely hopeless so long as 'the walls of the thorax are sufficiently firm for the purposes of respiration, and the bones of the spinal column are prevented from injuring the most vital parts of the cord.'

With these symptoms it is not surprising that this disease should have been claimed as merely a rarer form of several better-known affections of bone, to all of which it bears some resemblance, however little they may seem to bear to each other. Some authors [1] consider mollities to be merely fatty degeneration, or atrophy of bone; others regard it as rickets attacking the adult; while many class it with cancer. Now each of these opinions has a basis of probability, and it is very possible that many of the cases of so-called mollities might with great propriety have been entitled 'atrophy' of the bone. Of this Mr. Curling's case appears to have been a good instance; and the difficulty which some authors have expressed in distinguishing between mollities and fragilitas ossium [2] appears to have arisen from their having compared together cases in which there was no real difference, and where the name mollities had been given to simple atrophy.

The connection between rickets and mollities appears, at first sight, a very close one, on account of the bending of the bones, and liability to fracture from slight causes, which characterise both. Some patients, also affected with undoubted mollities, have suffered in their youth from rickets.[3] Still, if we consider the question attentively, the differences between the two affections far exceed their resemblances. Rickets is an affection of early life, closely allied to scrofula in its causation and in its cure; it is peculiarly amenable to treatment; and under favourable circumstances the constitutional cachexia, which is its essence, readily disappears as the child grows. Mollities hardly ever makes its first appearance till middle life; and, even in those cases where the patient has been rickety, not till long after the cachexia of that disease has subsided; it shows no alliance with scrofula, and is rarely amenable either to the remedies for that disease, or, as far as is known, to any other remedies, but pursues its career steadily, unaffected for good by any medical treatment.

In the latter particular, as in several of its other features, it bears a far stronger resemblance to cancer. In fact, there can be little hesitation in classing some specimens preserved in museums as mollities under the head of diffused cancer; and conversely, in recorded cases of cancer, some of the bones have been found in a state closely resembling, if not identical with, mollities.

Thus in a case of secondary cancer in the spine and other parts, after removal of scirrhus of the breast, related by Mr. Cæsar Hawkins,[4] it is noted that 'the centre of the neck appeared a little sunk forward, as if the upper vertebræ had been depressed in that position;' and the anatomy of the affected bone is thus described: 'The body of the fifth cervical vertebra was very irregular on its surface, and was softened throughout, with much enlargement of the cells of the cancelli, which were filled with a sanguineous pulpy fluid; the two adjoining vertebræ showed a lesser degree of the same morbid structure.'

But, allowing that many of the recorded cases of mollities may be referred to simple atrophy, and some of the others to cancer, there can still be no doubt of the existence of an independent disease to which that name is peculiarly appropriate.

In one sense, indeed, all cases of mollities may be said to be cases of atrophy, for the bony matter is greatly diminished, or even quite absorbed; but this proceeds, not from a deficiency of nutrition—in fact, the blood-supply appears at first, at any rate, excessive—but, from some error of nutrition, the nature of which is as yet unknown. Some pathologists have tried to connect it with an excess of lactic acid, which, circulating through the bone, produces disintegration of its lime-salts. Others

[1] See Mr. Curling's paper in *Med.-Chir. Trans.* vol. xx. p. 356.

[2] It would be well if the term fragilitas ossium were allowed to become obsolete, since it only describes a symptom common to several affections.

[3] This was the case with Dr. Ormerod's patient above referred to.

[4] *Med.-Chir. Trans.* vol. xxiv. p. 45. See also a case of cancer of the bones after scirrhus of the breast, described by the author in *Path. Soc. Trans.* vol. xi. p. 219, in which some of the ribs were perfectly flexible. In examining a case of well-marked cancer of the pelvis, I have found a condition of the innominate bone bearing an almost equally close resemblance to mollities.

refer it to an excessive demand for lime-salts during pregnancy, in order to form the skeleton of the fœtus. Dr. Bence Jones[1] tried to connect it with a supposed loss of a peculiar albuminoid product through the kidneys; but none of these explanations can at present be accepted. The alleged excess of lactic acid is quite unproved. The second explanation is very difficult in itself to accept, and is inconsistent with the fact that the disease occurs in males and in women who have never been pregnant; and subsequent observers have not been able to verify Dr. Bence Jones's observation. Mr. Durham says, however, that in every case known to him the history proves the existence of some influence, or combination of influences, capable of producing great general depression of the nervous system. A case reported in Charcot's lectures, as spontaneous fracture depending on disease of the spinal cord,[2] bears a great resemblance to some of the published cases of mollities.

The treatment must be directed to supporting the patient's strength, giving good food, attending to the digestion, administering cod-liver oil, quinine and iron, and rectifying as far as possible any malposition of the limbs. The fractures which occur in mollities are not usually insusceptible of union.

The more advanced cases are hardly subjects for treatment, since the disease in the bones and the distortion of the limbs has advanced to an unmanageable extent before the patient is seen; and it would be scarcely desirable, even if it were possible, to protract the course of a painless but inevitable decay.

Malignant tumours. Cancer or Sarcoma.—That most of the soft tumours of bone are highly malignant is unfortunately too true to be for a moment disputed; and, although the nomenclature of these tumours, now in common use, has changed since the general acceptance of the theories of German pathologists about the difference between sarcoma and carcinoma, yet the surgical indications remain the same, and the result of surgical treatment has not hitherto, I fear, greatly improved. I trust, however, that we may hope in the future for some improvement in the ultimate results of operations, from the more careful and extended study of such diseases which has been lately undertaken, and from the increased precision in diagnosis which certainly seems to have been attained.

In the last edition of this work such tumours were divided into cancers or malignant, and myeloid or non-malignant; with the reservation, however, that myeloid tumours sometimes prove malignant, and that, in some cases diagnosed as cancerous, amputation is permanently successful. This classification rested on purely clinical grounds. The new classification professes to be strictly anatomical; but it may be questioned whether it really is so, for it is largely influenced (to say the least) by the theory of Waldeyer, that carcinoma is derived from epithelial structures only—a theory of which no satisfactory anatomical proof has as yet been given. Consequently, as there is assumed[3] to be no epithelium in the bones, it follows by an easy process of reasoning that there can be no carcinoma in the bones, and that all soft tumours of bone must be sarcomatous. I must not spend time here on matters of pure speculation. All I need say is that many of the tumours classed as 'round-celled sarcoma' seem to me anatomically indistinguishable from carcinoma, and that they have every clinical character which pertains to cases of 'cancer,' however we define that term; for they sometimes affect the bones in numerous parts simultaneously,[4] spread rapidly from the bone to the neighbouring soft parts, affect the glands, reappear in the most remote and diverse parts of the body, and destroy life rapidly, whether they are removed or not, and however freely the parts may have been removed.

The soft rapidly-growing tumours of bone are now usually described as—1. myeloid or giant-celled sarcoma; 2. spindle-celled sarcoma; 3. round-celled sarcoma;

[1] *Phil. Trans.* vol. lxvi. p. 55. [2] *New Syd. Soc. Trans.* vol. ii. App. i.

[3] I say this is an assumption, since the vascular endothelium may be considered epithelial.

[4] A beautiful drawing in the Museum of St. George's Hospital, shows separate nodules of what I should call 'soft cancer,' or what others would call 'round-celled sarcoma,' affecting the femur, tibia and patella, and rapidly invading the parts around the bones. Ser. xxi. No. 29.

and, 4. osteoid sarcoma; for which latter term, however, numerous synonyms are in use. A further division is, in each case, into (*a*) periosteal, and (*b*) interstitial or central.

The bone in the neighbourhood of the cancerous deposit is often thickened,[1] sometimes to an extent that can be appreciated by external examination.

1. Myeloid tumour usually occupies the joint ends of the long bones,[2] or springs from the periosteum of the alveolar cavities in the jaws (myeloid epulis); but it is also found in other parts of the osseous system. Its minute anatomy has been described in the essay on Tumours. It forms a soft swelling, growing steadily, though not in general so rapidly as the tumours to be presently mentioned, often pulsating,[3] seldom spreading to the neighbouring structures or to the lymphatic glands, or infiltrating the medullary canal to any great extent, though to all these statements there are exceptions. The disease is undoubtedly in some cases malignant, *i.e.* liable to recur after removal, or even after amputation far away from the tumour; while in others recovery after removal is permanent. It is difficult to speak with confidence as to the prospect of recurrence, since it is difficult to obtain full and complete histories of patients who recover after amputation. Dr. Gross calculates that nearly a quarter (22·72 per cent.) of all his cases of myeloid tumour of the long bones have run a malignant course, the recurrence being not only local, or in the stump, but also general, and almost always in the lungs. The same observer believes that the presence of osteoid, or chondroid, formations in a myeloid tumour is of serious import as to its malignancy; that is to say, that the malignancy of a myeloid tumour may be regarded as due, at least in great part, to the presence of such deposits. Myeloid tumours sometimes undergo cystic degeneration ('myelocystic tumours'—Gray[4]), and they usually present in some parts a variable amount of fatty degeneration.

2, 3. Excluding what used to be called 'osteoid cancer,' the other rapidly growing tumours of bone are classified by those who regard all these growths as sarcomata with the 'spindle-celled' and the 'round-celled,' the former being the tumours originally described by Lebert and Paget as 'fibroplastic' or 'recurrent fibroid,' and the latter those which are otherwise (and in many cases better, in my opinion,) denominated 'encephaloid cancer.' Both kinds grow either centrally or subperiosteally. Both are usually malignant, especially the latter, which is regarded as a form of cancer by observers so eminent as Paget, Rindfleisch, and Cornil et Ranvier.[5]

4. The osteoid or calcifying, or partly ossifying malignant tumours, form a class which it is very difficult indeed to separate accurately from the others—if, indeed, there be any radical difference. The chief reason for classifying these tumours by

[1] Paget, *Surg. Path.* vol. ii. p. 362, ed. 1853; *Path. Soc. Trans.* vol. x. p. 249.

[2] Of seventy recorded examples of myeloid tumour of the long bones, according to Dr. S. W. Gross (*Amer. Journ. of Med. Science*, July and Oct. 1879), only four sprang from the diaphysis. In the long bones the myeloid tumours are generally central, *i.e.* arising from the medullary tissue.

[3] In Dr. Gross's collection of cases above referred to, pulsation was noticed in one-fifth of the myeloid tumours of the long bones.

[4] *Med.-Chir. Trans.* vol. xxxix.

[5] Dr. Gross divides the round-celled sarcomata into alveolar, lymphadenoid, and granulation-like or hæmatoid, and he gives the following as the differences between the alveolar form and carcinoma. 'The points of distinction are, first, that the cells are intimately connected with the walls of the alveoli or the vessels which form the alveoli; secondly, that, by pencilling, an intercellular substance, like that met with in the lymphadenoid form of tumour, is disclosed, the fibres of which arise from the coarser trabeculæ which separate the tissue into groups of cells; and, thirdly, that the cells are pretty uniform in shape and size, being round and oval, and about the dimensions of a white blood corpuscle. In carcinoma, the cells are of an epithelial type, loosely heaped in the loculi, without the intervention of intercellular substance, and polymorphous, and vary greatly in size. In other words, in alveolar sarcoma the stroma and cells are intimately interwoven into a single tissue, whereas in carcinoma, the cells and stroma are easily separable into two distinct tissues.' I should observe that these minute microscopical differences are in the highest degree uncertain; and would probably be very differently estimated by equally skilled observers, if unfettered by a previous theory. They certainly appear too weak to prove the permanent foundation of a surgical classification.

themselves as 'osteoid cancer' (a classification which I still think better than the one now in vogue) is the singular circumstance that osteoid or chondroid deposit not unfrequently occurs in the glands and the viscera, and that the disease may recur as a chondroid or osteoid tumour in the viscera, even in cases where there is no local recurrence. Possibly in some cases the formation of bone, or some imperfect resemblance of bone, in these tumours is primary; but in most cases it seems as if the tissue of a soft tumour were invaded by calcification or ossification. The nomenclature of these osteoid tumours must of course depend on that of the soft tumours, of which there are confessedly a variety. If all the malignant tumours of bone are to be called sarcomata, the osteoid must bear the same qualification, absurd as the term seems. But the arrangement is a highly unsatisfactory one, for, except in the anatomical analogy which exists between bone and other connective tissues, these tumours present none of the features which were originally described as characteristic of sarcoma, for they are usually highly malignant, and recur, not locally, but in remote parts; and they invade the lymphatic glands, often at an early period of the disease. But in striking contrast to these very malignant osteoid tumours, which I would still call osteoid 'cancers,' there are others which are only locally malignant—*i.e.* recurrent—which do not threaten life unless by their pressure, and which in all clinical respects bear the strongest analogy to the 'recurrent fibroid' tumours of Lebert and Paget. Such cases I would class apart from the cancerous tumours by some such term as 'diffused bony' or 'recurrent osteoid' tumours; and they will be found described in the sequel with exostoses.

Fig. 55.—Melanotic Cancer infiltrating the cancellous interior of the shafts of the long bones. From a preparation (Series ii. No. 234) presented to the Museum of St. George's Hospital by Mr. Campbell De Morgan.

Sections of the humerus:—*a*, a section taken somewhat parallel to the axis of the bone through its cancellous portion, showing the uniform infiltration of the cells with melanotic matter. *b*, a transverse section. The cortex of the bone is seen to be quite free in this section, but at other parts a few points of melanotic deposit were met with. The preparation was taken from the body of a woman who had been operated upon for the removal of a melanotic tumour. The disease returned in various parts of the body. The whole skin resembled that of a person who had long taken nitrate of silver, and melanotic matter was found both in the rete mucosum and in the derma. There was also extensive deposit in many of the internal organs.

In exceptional cases deposits are found in the bones secondary to carcinoma elsewhere which can hardly be regarded as otherwise than carcinomatous. Thus, after scirrhus of the breast, I have seen deposits in various bones which could hardly be regarded as otherwise than scirrhous.[1] These deposits were in the form of small irregular lumps, creaking under the knife, emitting a very scanty juice, and presenting under the microscope, besides a good deal of common fibrous tissue, only small nuclear bodies, and those in no very large proportion. They bore a sufficiently close resemblance to scirrhus in other parts to deserve the same name, more especially as they were only another product of the selfsame disease. Epithelial cancer attacks bones usually in the course of a cancerous ulceration of the soft parts which cover them, but scattered instances of its occurrence as a primary disease are on record. Thus in the 'Path. Soc. Transactions,' ix. 358 will be found a description of this disease in the base of the skull. It presented the appearance of a mass of fibroid tissue, the meshes of which were filled with a yellow opaque and thick material, which could be squeezed out in the form of commedones, and consisted of a mass of epithelial scales. But these cases are of too rare occurrence to have much practical import-

[1] *Path. Trans.* xi. 219.

ance; nor in the few scattered cases of colloid disease affecting bones with which I am acquainted is there anything to throw light on the controversy as to the malignant or non-malignant nature of that affection. Melanosis affects bones very rarely, and probably is always a secondary formation; as in the case which has furnished fig. 55.

It seems to result from this that our means of classifying the soft and rapidly growing tumours of bone for any useful surgical purpose are as yet very inadequate. It matters little whether we call a tumour by one name or another, or entertain one or another theory about the tissue in which it originates, so long as we are obliged to confess that we have no resource except immediate amputation, and even then can form no definite idea of the patient's prospects after the operation.

The rules, however, for diagnosing these tumours have undoubtedly acquired some increased precision in this search after classification, In the first place, there may be some difficulty in diagnosing a soft tumour in its early stage from an abscess. The question occurs only, as far as I have seen, in the neighbourhood of a joint; where also the doubt sometimes is, whether the swelling is not due to thickening of the synovial membrane. Generally speaking, however, the soft tumour is limited to one portion of the circumference of the bone, while disease of the synovial membrane would involve the whole circumference, although not necessarily equally prominent over the whole. Further, the chronic thickening of the synovial membrane will have been preceded by a long course of symptoms of disease in the joint, and these symptoms will probably have been more acute at some previous time; while the tumour will have commenced much more recently, at first without any symptoms, and the symptoms will have been more marked as the tumour got larger. Limited abscesses, also, in the thickness of the swelling, are common in the chronic synovial disease, while abscess is a rare complication in the course of a tumour, and then forms external to it and singly.

The following instance of the occurrence of abscess around a rapidly growing tumour will illustrate the difficulty of the diagnosis in such a case. A young woman was admitted into St. George's Hospital under the care of Mr. Cæsar Hawkins, complaining of pain near the ankle; no diseased appearance then existed. Soon, however, a soft swelling made its appearance, fluctuation was detected, and an incision behind the internal malleolus gave exit to pus mixed with blood, and exposed a cavity which appeared to be that of an ordinary abscess. After a few days arterial hæmorrhage came on, and soon became uncontrollable. Pulsation also became evident in the swelling. The incision was extended, and several pieces of soft, breaking-down tissue escaped; the finger passed into a mass of fungous matter springing from the os calcis. After amputation the disease was seen to be a soft tumour, about the size of a walnut, connected by a broad base to the calcaneum, and surrounding the posterior tibial vessels. The artery showed a small perforation.

It is seldom, however, that such difficulty is experienced as in this case in forming the diagnosis; and if from the ambiguity of the symptoms, and the thickness or tension of the soft parts over the swelling, doubt is felt as to the presence of a soft solid or a collection of fluid, the introduction of a grooved needle will in most cases decide the question. Usually the lobulated surface of the tumour, and the healthy and uninflamed state of its coverings, suffice to distinguish it from an abscess. The diagnosis between a large deposit from periostitis and the early stage of a malignant tumour depends chiefly on the more limited extent of the tumour, and its more rapid growth; but it is not always easy at first, and thus requires some watching of the case, and the trial of a course of iodicle of potassium or mercury. Mr. Morrant Baker's case, referred to on p. 297, will show the possibility, even with all due care, of mistaking the results of common inflammation for those of malignant disease.

In the early stages of soft tumours which pulsate there is often a question as to whether the disease is aneurismal or no; but on this head I think it better to refer to the essay on ANEURISM.

Having settled the diagnosis so far as to determine that the tumour is one of the so-called sarcomata, its position and nature may usually be inferred with tolerable accuracy. With regard to the central or peripheral origin of the growth: a tumour may be regarded as central when its appearance is preceded by a constant aching pain in the spot where it afterwards presents itself; which pain disappears or is

much mitigated as soon as a soft spot in the bone marks the issue of the tumour through its case of bone and periosteum, and this inference is converted into a certainty if the bone suddenly gives way.[1] If the tumour pulsates, it is probably myeloid, though it may be round-celled. If it occurs near an epiphysis, the chances are that it is the former; if in the shaft, probably the latter.

On the other hand, a tumour which grows like a large ferule around the bone, unaccompanied by pulsation, and with no tendency to fracture, and in which the pain is constant, though not usually excessive, may be assumed to be periosteal. If its rate of growth is rapid, and if the glands are infected, or the tumour is covered with large veins, or any other striking feature of malignancy is displayed, it will be of the round-celled (cancerous?) variety—otherwise myeloid or spindle-celled—the former more probably if near the head of the bone.

Osteoid deposit to any great extent is certainly a very unfavourable feature, and especially so if the glands are of bony hardness. There is usually no difficulty in distinguishing between a malignant osteoid or chondroid growth and a common enchondroma, from the slow progress, painlessness, bossy surface, and absence of all serious symptoms in the latter, as contrasted with the distinctly cancerous history and course of the former.

Treatment.—The diagnosis being established, there is no doubt that amputation should be urged in all cases where the long bones are affected, except those in which there are already symptoms of general infection, such as unmistakable deposit in the glands—not merely enlargement which may be due to irritation—constant hacking cough and blood-spitting, enlargement of the liver or any other symptom of visceral deposit. Whether it is in all cases necessary to amputate above the head of the affected bone is doubtful. My own impression is that, provided amputation is done at a level considerably above the affected part,[2] it is not necessary to remove the whole bone. This is illustrated by a case published by me in the 'British Medical Journal,' July 17, 1880, where the thigh had been amputated eight years previously for a rapidly-growing periosteal tumour of the femur, pronounced to be medullary cancer, and in which there was some enlargement of the inguinal glands on both sides. The patient was (and is) in perfect health. I have met with other similar cases, so that in tumours of the lower end of the femur, I should be disposed to amputate below the hip; though where the tibia, or fibula, or bones of the forearm are the seat of the disease, as there is little extra risk in amputating above the joint, that course is the wiser. The malignant tumours of the humerus which I have met with have been seated so high on the bone as to necessitate amputation at the shoulder; but, if seated low down, I do not see why they should not be treated by amputation through the shaft of the bone.

In the long bones I should earnestly dissuade either the resection of the portion of bone affected or the enucleation of the tumour.[3] I had reason to regret having a short time ago, in deference to the wishes of the patient, enucleated a myeloid tumour of the tibia, instead of performing amputation. Abscess spread into the knee-joint, and compelled amputation when the patient was too weak to rally from it. But where amputation is impossible, the attempt ought doubtless to be made—the bone being, if possible, freely resected at a distance from the morbid growth. Where this cannot be done, the tumour must be completely enucleated and the bleeding stanched with the actual cautery, any fresh outgrowths being treated in the same way.

[1] Such spontaneous fractures are not insusceptible of union. Numerous instances are now on record. See the case above referred to, in *Path. Trans.* xi. 219.

[2] This is undoubtedly necessary, especially if the tumour be central. In a man who was under my care some time ago with a central tumour of this nature presenting in the upper third of the thigh, we found after amputation at the hip, that the medullary tissue was invaded by the growth as high as the neck of the bone.

[3] I am aware that cases have occurred in which the shaft of the affected bone has been resected with success for myeloid tumour. (See Gross, *op. cit.* pp. 49, 56). I would not refuse to follow such a course in an otherwise favourable case, if the patient declined amputation, but I should think it dangerous.

Osteo-aneurism.—Ever since the days of Breschet, pulsatile tumours of bone have been described as osteo-aneurism, by which is intended expansions of the wall of the bone by capillaries sufficiently enlarged to pulsate, as such enlarged vessels do in aneurism by anastomosis in the soft parts. There can be no doubt that the great majority at any rate, if not all the cases, described under this head by the older surgeons were myeloid or other soft tumours in which, as we have seen, pulsation is often an early symptom, before the solid matter has attained any large size. Whether all of them are of this nature must be left to the reader's judgment. Many good surgeons think so, including the most recent writer on the subject whom I have met with.[1]

The only two cases as far as I am aware which could at all support the view that pulsating tumours of bone occur, which are not sarcomatous or carcinomatous, but mere dilatations of the vessels of the bone, are the following. The first was published by Dr. Mapother in the *Dublin Med. Press*, February 4, 1863, p. 105. In this case there was a pulsating tumour of small size situated on the tibia, accompanied by a distinct thrill and slight bruit; but without any indication of disease in other parts of the osseous system or in the body generally. The diseased tissue was destroyed by two applications of the actual cautery, in doing which its vascular nature was clearly testified by the acute hæmorrhage. No other morbid tissue was exposed by the opening which was made into the tumour; but there was, of course, no opportunity for anatomical examination. The wound healed perfectly, and I am told by Dr. Mapother that the patient remained in good health two and a half years afterwards.

Again, in the *Path. Trans.* vol. xix. 349, is the account by Mr. Bickersteth of a case where he amputated the leg on account of a pulsating tumour of the tibia, which 'felt firm, but was slightly compressible, yielding to deep pressure, and giving a spongy feel to the finger, with an occasional sensation of crackling. The skin was free and sound. No bruit was audible.' An incision was made into the tumour, which exposed a surface having all the appearance of malignant disease, and the leg was amputated under the idea that the tumour was cancerous. On examination of the tibia in front, it was found much expanded at its lower end, where a mere shell of bone remained, bending and crackling under the finger. Behind was a large oval tumour, five inches long by three broad, springing from the posterior and outer side of the expanded tibia, and running upwards from the lower end of that bone into the interosseous space, overlapping the fibula, but not connected with it. It had a distinct wall, and was divided into two parts by the tendons of the tibialis posticus and flexor longus digitorum, which ran in a groove or channel in the tumour, through nearly its whole length. The bulk of the tumour was found to consist of innumerable trabecular spaces; the fibrous bands composing which, as well as the walls of the tumour, were derived from the periosteum of the tibia. These spaces were filled with clotted blood. All parts of the tumour communicated with each other.[2] There was no admixture of cancerous matter; and the case appeared, both to Mr. Bickersteth and to the committee of the Pathological Society who examined it, to be a perfect example of aneurismal dilatation of the vascular spaces of the bone.

Mr. Bickersteth had the kindness to inform me that he saw the patient many years afterwards perfectly well.

Admitting, therefore, the possibility that in such a case as Dr. Mapother's, the tumour might be found to consist only of vascular tissue, we must also admit that the course he pursued was justifiable; *i.e.* that in a small pulsatile growth from bone, where no soft solid structure can be discovered, it may be justifiable to remove the growth either by the cautery alone or (perhaps better) by excision combined with the cautery; but I confess that I should always regard amputation as the safer course.

Cancerous ulceration is usually preceded by a known and evident tumour, probably epithelial; but in some cases the malignant deposit may have been entirely interstitial, and in others the patient is not seen until extensive ulceration has destroyed any tumour that might have existed. Such cases occur most usually about the bones of the face; and I have seen death produced where the lower jaw was implicated in a case of this kind, by the extension of the ulceration into the lingual artery. During life some difficulty may be experienced in distinguishing this cancerous affection from the rodent or phagedænic ulceration, spoken of at p. 292; but it is a matter of little practical importance, since amputation or complete excision would be recommended in either case, if the patient's general condition admitted of it. The bones of the face are peculiarly liable to extensive destruction in cancroid ulceration and in lupus, but the chronic course of these affections sufficiently distinguishes them from cancer.

[1] Landi, quoted in *Lond. Med. Record*, Nov. 15, 1877.

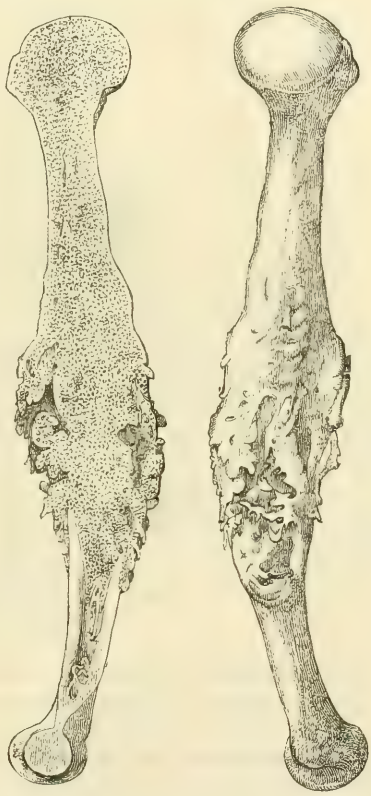
[2] The preparation is preserved in the Museum of the Liverpool School of Medicine.

In the macerated bone, malignant ulceration produces extensive and irregular destruction both of the compact and cancellous tissue, without any trace of the periosteal and other inflammatory deposit that bounds the more healthy forms of ulceration (see fig. 56).

Non-malignant tumours.—The tumours which may, without hesitation, be regarded as innocent are those which present a complete resemblance (homology) to the natural tissues of bone; *i.e.* the cartilage, the osseous tissue, the fibrous membranes, and the spaces or cancelli.[1] Hence they are described as cartilaginous (enchondromata), bony (exostoses), fibrous, fibroid or fibro-cystic, and cystic tumours, to which entozo must be added. The sarcomatous tumours present, as we have seen, a dubious analogy to the natural tissues, and their claim to the title non-malignant is still more dubious.

Fig. 56.—Malignant Ulceration of Bone. (Museum of the Royal College of Surgeons. No. 640.)

Fig. 57.—The Humerus in a case of diffused Cartilaginous Tumour. (Museum of St. George's Hospital. Series ii. No. 183.)



Enchondroma.—Cartilaginous and bony tumours can hardly be treated of separately, for although the well-marked specimens of either class present little similarity at first sight, some of each are so intimately related, that the two could not without confusion be made the subjects of separate sections.

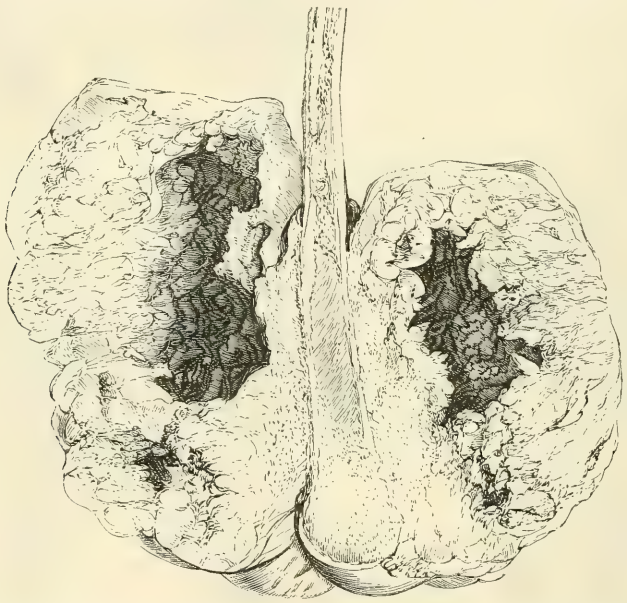
Cartilaginous tumours, or enchondromata, as they are called, have been already described in the essay on Tumours (vol. i. p. 264), so that it now only remains to speak of them as they affect the bones.

These formations may be divided, for surgical purposes, into two classes: the circumscribed and the diffused. The former as a rule do, and the latter do not

[1] We have discussed above the question of the reality of the growths described as osteo-aneurism. If they occur, they are the homologues of the vessels, or rather outgrowths from them.

show a tendency to ossify throughout their whole extent; although even in the diffused enchondromata the part of the bone from which they spring is often occupied by a considerable osseous deposit, while the bulk of the tumour remains unossified. The diffused enchondromata usually grow as extensive infiltrations into the tissue of the bone and periosteum, and in the course of time spread slowly over the surface of the bone (retaining for the most part their covering of periosteum), and fill all the spaces or cavities in relation with the bone. Such was the case in the instance shown in fig. 57, where the whole medullary canal of the shaft of the humerus is occupied for a considerable extent by porous bone forming the base of a cartilaginous tumour, which surrounded the bone, and had been growing for a long period without much inconvenience to the patient. It is difficult to determine their precise origin, and thus to make sure whether they are new formations, in a strict sense, or out-growths. The former opinion seems more generally probable, but it is possible that some of them originate in early life as out-growths from the epiphysial cartilage. These non-ossifying cartilaginous tumours, or pure enchondromata, are little amenable to surgical treatment, unless in a part favourable for amputation.

Fig. 58.—Cystic Enchondroma. (Museum of the Royal College of Surgeons. No. 203A.)



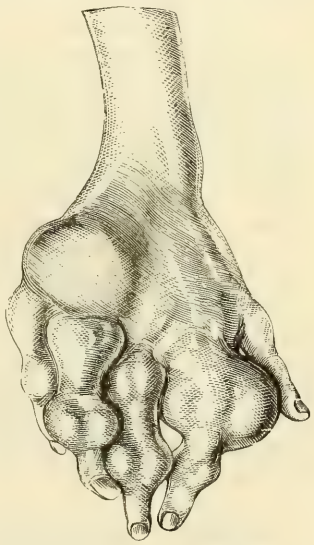
They have been supposed to present some analogy to malignant diseases, to which, indeed, their extensive diffusion and steady irresistible progress do offer a resemblance. They differ, however—from the true cancers, at any rate—in one feature, which is quite characteristic, viz. that, however extensive their diffusion, they affect the surrounding parts only by pressure or absorption, not by contamination. This is their most distinctive feature; but it is not so useful in diagnosis (since it is less easily appreciated during life) as their rate of growth, which is usually slow. To this rule there are, however, rather frequent exceptions, of which three remarkable instances are related by Sir J. Paget,[1] in one of which the rapid growth of the tumour led to the erroneous diagnosis of malignancy, and so deprived the patient of the chance of recovery which amputation would have given him. Remembering these and similar cases, we must not be too confident in inferring malignancy in the case of a tumour of bone from the single fact of rapidity of growth, although that is, doubtless, a most suspicious and unfavourable symptom. In many cases these large cartilaginous tumours remain stationary for a long period; and this should be taken into consideration when consulting on the propriety of amputation.

[1] *Lectures on Surg. Path.* vol. ii. p. 181, ed. 1853.

The structure of these tumours varies; usually they are quite solid; in other cases cysts, filled with fluid, are found in them, as in the beautiful specimen from which fig. 58 was taken. They sometimes consist exclusively of cartilage; but more commonly fibrous tissue is to be found, in sparing quantity, in some parts of them. The microscopical appearances will be found described in the essay above referred to.

The circumscribed cartilaginous tumours are, however, much more frequently met with, and are, therefore, more important in practical surgery. They spring almost exclusively from the long bones, the phalanges of the fingers and toes being their most frequent seat. A small enchondroma is comparatively often met with, springing from the end of the last phalanx of the great toe, raising the nail up, and giving a good deal of pain in wearing the boot. It should be cut away from the bone, and usually will not return; should it do so, the phalanx must be removed. In the hand and foot enchondromata are often found in great numbers at the same time; and the appearance thus presented is very characteristic, and is not, as far as I know, imitated by tumours of any other kind. The fingers are studded over with bosses or knobs, looking something like the dry gnarled branches of an old tree. Of this form of disease the annexed is a good illustration. This affection is seen generally about the age of puberty. It is, of course, quite incurable, except by amputation; but that measure should never be resorted to in any disease of the hand without evident necessity. In the foot less scruple need be entertained, since the foot, deprived of its anterior portion, is still a very useful member; and there would be no necessity, even in a very advanced case, for going further than Lisfranc's or Chopart's operation. I have never seen a case where anything more was required than to remove one or two toes. In the hands these multiple enchondromata, if left alone, grow generally very slowly, and sometimes not at all. Cases are, however, on record where they seem to have increased slowly during the whole period of life, and to have attained at length a truly extraordinary development. Of this the specimen figured by Müller [1] is an excellent instance; and a very similar case has been described and figured by the writer,[2] where, however, the cartilaginous structure was less distinct. Such tumours usually originate in the interior of a bone, expanding its walls into a thin bony cyst or shell, which is liable to give way at different parts, and firm pressure will then elicit a feeling of crepitation (see fig. 60, on p. 325). These multiple enchondromata, like the diffused cartilaginous tumours just described, seem to show little tendency to ossify in the strict sense of the term; but they undergo, when very old, a process of calcareous degeneration, which, added to their general increase in size, produces ulceration of the skin over them; and so a condition is brought about not unlike that of a mass of enormous chalkstones exposed. More rarely the tumours spring from the surface of the bones.[3]

Fig. 59.—Model of a Hand affected with numerous Enchondromata. (From the Museum of St. George's Hospital.)



[1] *Ueber den feinern Bau und die Formen der krankhaften Geschwülste.* Berlin, 1838, tab. iv. fig. 1.

[2] *Path. Soc. Trans.* vol. ix. p. 382. The specimen is in the Museum of St. George's Hospital.

[3] With regard to the ordinary seat of cartilaginous tumours of bone, Dr. Pirrie makes the following observations, which I believe to be generally true: 'I have now seen in my own experience nine specimens of cartilaginous tumours near the ends of long bones, and they have all been situated between the walls of the bone and the periosteum, and in no instance extended to the cartilage of incrustation at the end of the bone. I have met with fifteen

Circumscribed and solitary enchondromata usually grow from the surface of a bone, and most of them show a strong tendency to ossify, the process commencing generally at the base. Hence the surgical considerations applicable to them are identical with those which apply to exostosis. When a circumscribed enchondroma grows in the interior of a bone, as in fig. 60, it can be readily enucleated, and when a small cartilaginous tumour springs (as it often does) from the end of the last phalanx, usually of the great toe, its removal is very easy, and is always, as far as I have seen, permanently successful.

Diagnosis.—The diagnosis of innocent tumours from each other is uncertain and obscure in all parts of the body, and perhaps more so when they are connected with the bones, on account of the generally deep position of the latter. If, however, a tumour presenting the general characters of innocency can be clearly made out to be springing from bone, the chances are very great in favour of its being an enchondroma or an exostosis. If very large, it can hardly be the latter without displaying characteristic hardness. Fibrous and fibroid tumours may be found of large size; still almost all large non-malignant tumours of bone are cartilaginous. Most, also, of the smaller tumours, which do not possess the hardness of exostosis, will be found to be cartilaginous. Such tumours usually possess a certain amount of resilience, and often appear obscurely movable on the bone. This sensation, however, is often deceptive, and due, apparently, to the motion of the soft parts upon the tumour; it has been noticed in tumours the base of which has been found to be completely ossified, and a slight amount of apparent movement is therefore no conclusive reason for denying the connection of a tumour with the bone. Another thing which ought to be taken into account in diagnosis is, that the cartilaginous, equally with the osseous, tumours may have a bursa over them. This will not often be an obstacle in the way of making out an exostosis, since the hardness of the latter is transmitted through the fluid, but may sometimes cause doubt about the nature of an enchondroma. The nodulated surface of enchondroma, though characteristic to a certain extent, is far from distinctive of the disease; the same property may belong to colloid disease, fibrous tumour, and other swellings; in fact, the only sensation which affords a reasonable ground for pronouncing a tumour cartilaginous is resilience combined with solidity; and this for deep-seated tumours is often deceptive, and in the many enchondromata enclosed in shells of bone is, of course, absent. On the whole, therefore, an enchondroma is best known by its being an innocent, and not osseous, tumour; elastic when firmly pressed, generally growing slowly, and not affecting the skin. When the phalanges are the seat of the disease, the diagnosis is much more nearly certain.

Exostosis.—The transition from cartilaginous to bony tumours is a natural one, since so many of the former are merely the first stage of growth of the latter. The term 'exostosis' is not a very easy one to define. It ought to be used only to signify an innocent tumour, or limited outgrowth, formed exclusively of bone, and not the result of inflammatory action; but, on the one hand, the products of inflammation secreted by the periosteum often assume the form of a limited outgrowth or tumour: while, on the other, many complex malignant tumours possess a bony framework, and, after maceration, bear a great resemblance to exostosis. In the latter case the distinction, though occasionally difficult after the bone has been macerated, is easy during life; so that the mere fact that a malignant tumour possesses a more or less perfect bony framework is of little moment in a practical point of view. Most of the growths which fall under the category of 'periosteal

examples in metarcarpal bones, and they all originated within the bone, and caused more or less of expansion of the walls and their conversion into a thin crust or shell around the tumour, in various instances at parts completely absorbed. I have seen and carefully examined seven examples of the same kind of growth in the middle of the long bones, and they were all placed within the canal and around the wall of the bone. Judging from my own comparatively limited experience, I would conclude that the favourite site of the first class is around the bone; of the second within it: and of the third, both within and around it.'—*On Acupressure*, p. 107.

exostosis'[1] are extensive inflammatory deposits beneath the periosteum, which neither require nor admit of surgical treatment. Whether limited, pedunculated, and therefore removable, tumours ever occur as a consequence of inflammation is as yet doubtful; but we may admit that it is, at least, possible.

The great majority, however, of those bony tumours which are called, in surgical language, exostoses, originate by an out-growth or limited hypertrophy of analogous parts, just as fatty, fibrous, and other innocent tumours do, quite independent of any inflammatory symptoms. Many authors, especially the French surgeons, speak of 'bullous exostoses,' meaning apparently by this term those shells of bone which sometimes are formed by the development of a tumour (generally cartilaginous) in the centre of a shaft. Such a case was the one from which fig. 60 is taken. Another kind of exostosis is that which proceeds from the ossification of tendons, or from the occurrence in man of processes of bone natural to the lower animals. Both of these belong rather to the class of museum curiosities than of subjects of practical interest.

Excluding these rarer varieties, the cases of circumscribed exostosis which surgeons have to treat are divided into two classes—the cancellous, and the ivory; the former being a reproduction of the tissue of the interior, as the latter is of the hard exterior of the bone. They will be found described in the essay on Tumours (vol. i. p. 266).

Fig. 60.—Bullous Exostosis on the Phalanx of a finger; probably a shell of bone expanded around a cartilaginous tumour. (From a preparation in St. George's Hospital Museum, Series ii. No. 151.)

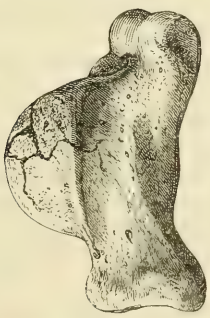


Fig. 61.—Ivory Exostosis which was trephined unsuccessfully, on account of its great hardness. Exfoliation was afterwards produced by the long-continued application of caustics — chiefly nitric acid. (From the Museum of St. George's Hospital, Series ii. No. 189.)

Treatment.—The slow rate at which exostoses progress, and the ease with which these soft parts accommodate themselves to the gradual advance of the tumour, render it frequently unnecessary to meddle with them; and it is always right to defer the operation until it is clearly seen to be necessary; since there is always some risk in operating on any deep-seated tumour, and still more in laying open the cancelli of bone, as must be done in dividing the neck of an exostosis. When the exostosis is of the ivory variety, and situated on the cranium, the operation is much more dangerous. Here, indeed, it not unfrequently happens that the tumour is so hard as to resist all the tools which can be brought to bear upon it, so that it is physically impossible to remove it.

A striking example of this occurred in a case which has furnished a preparation to the Museum of St. George's Hospital. A man, suffering from a small ivory exostosis in the frontal region, fell under the care of the late Mr. Keate, one of the boldest and most skilful operators of his day, who, perseveringly, but vainly, endeavoured, by the use of trephine, saw, chisel, and mallet, during the space of nearly two hours, to cut off the little lump of hard bone. The patient was fortunate enough to recover from this proceeding; and Mr. Keate, convinced of the uselessness of further operation, determined to attempt the extirpation of the tumour by the free application of potassa fusa and nitric acid to its exposed base. This was successful.

[1] See Gerdy, *Maladies des Organes des Mouvements*, p. 272; Fano's edition of Vidal de Cassis, *Pathologie externe*, vol. ii. p. 261.

The caustics, in the course of years, ate their way through the base of the tumour, which dropped off. The tumour figured in the accompanying illustration (fig. 61) still shows the deep groove worked into it by the trephine at the time of the operation.

It would rash to say that such operations are unjustifiable, since exostosis in the neighbourhood of the orbit may grow into that cavity, or into the cranium, and cause death, or some horrible deformity almost worse than death, by displacement of the eyes, or the bones of the face;[1] but the risks of operating on these small exostoses on the cranium should be maturely weighed. Some tumours, however, which present on the surface the character of the true ivory exostosis, may turn out on section to be hard only on the exterior, and to consist of a soft diploic tissue internally. This is the case usually, if not solely, when the bone from which the tumour springs resembles the composition of the vault of the skull—that is to say, consists of diploë covered by a thin table of compact tissue. In bones of which the shell is more dense, such as the lower jaw, it is much more probable that the whole thickness of the tumour will be of compact structure. Another circumstance which renders the prospect of operations on large exostoses, whether on the skull or other parts, rather more promising than would appear at first sight, is that the tumour when exposed is sometimes found to be connected to the surface of the bone by a very narrow neck, from which it can be easily broken or cut off.[2] It is, however, only rarely that either the surgeon or the patient will make up his mind to the dangerous and doubtful experiment of an operation on an ivory exostosis, especially of the cranium; whereas operations on the more common forms of exostoses which spring from the shafts of the long bones, and present the cancellous, or mixed cartilaginous structure, are of daily occurrence. Their most common situation, after the phalanges, is near the knee, springing from the inner surface of the femur, a little above the condyle. Another very common situation is beneath the deltoid muscle.

The removal of such an exostosis is, in most cases, easy, since the base is not generally very broad, nor the ossification very compact. Some are even so soft as to be divisible with a strong scalpel. A few again are not united to the shaft by bony matter, but by ligamentous union; usually as the result of fracture of the base of the exostosis, sometimes possibly from partial ossification of an enchondroma, and even perhaps from the formation of bony tumour in the soft parts near the bone. This condition is highly favourable for operation, not merely because the tumour can be more easily excised, but also because the vascular spaces in the bone will not be laid open in the operation.

In other cases the tumour is broader, and more firmly ossified at its base than in any other part, and these are the least favourable cases for operation, since the division of so large a mass of bone requires great and prolonged violence, peculiarly likely to be followed by the complications above enumerated. But the operation is necessary when the tumour is growing, and is threatening the functions of important parts; and in such cases the operator must be prepared for the difficulties which he may have to encounter, and should have a sufficient supply of instruments of adequate strength at hand, such as stout bone-nippers, a chain-saw, other saws of various shapes, chisels, and mallet. In all cases the base of the tumour should be clearly exposed, and separated with care from the parts around, which may require to be held back with retractors. The separation should be commenced from the side where any danger is to be apprehended (*e.g.* in consequence of the proximity of a vessel or joint), in order to avoid implicating any important part; and then any amount of force necessary must be carefully but firmly applied, the bone being steadied by assistants.[3] The antiseptic method is now almost universally employed.

[1] Some remarkable specimens are in the Museums of St. Bartholomew's Hospital and of the College of Surgeons. Exostoses of the orbit are not always of this dense quality. See a case in *Path. Soc. Trans.* vol. xi. p. 264, where the tumour was soft, and easily removed.

[2] A most interesting case of a tumour of this kind, growing from the cranium, is reported in the *Path. Soc. Trans.* for 1850, p. 149, with a drawing, and has been commented on by Mr. Prescott Hewett, in his Lectures on 'Diseases of the Head.'

[3] It may not, perhaps, be out of place to remark, that in case of an exostosis situated near

Some surgeons, and especially the late Mr. Maunder,[1] have recommended the subcutaneous section of the neck of an exostosis, or its fracture without any incision. The bony mass is to be prevented from reuniting to the surface of the bone by reiterated passive motion. I have tried this plan once or twice, and seen it tried by others, but never with success, as the tumour always reunited to the bone. Still in situations where the removal of the tumour would be peculiarly hazardous, and where its base is narrow, the plan deserves a trial.

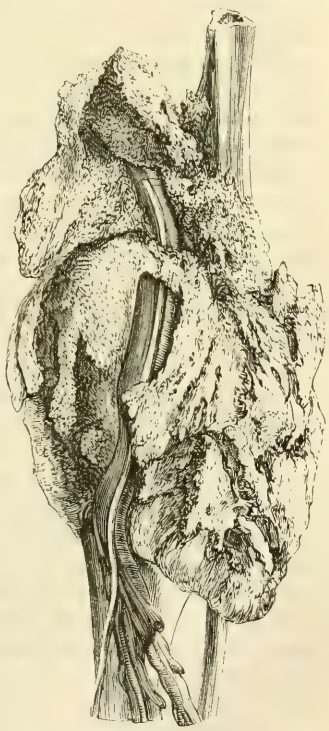
The 'bullous exostosis,' or central enchondroma contained in a bony cyst, usually requires amputation of the phalanx upon which it is seated. It may, indeed, be sometimes possible to enucleate the growth, and I have seen this done with success; but as a general rule it is hardly worth while to attempt it; since, if the disease be seated in the hand, the necessary disturbance of the tendons would probably render the finger useless; and if in the foot, the certainty of a speedy and complete recovery would outweigh the advantage of preserving a portion of one of the toes.

Diffused bony, or innocent osteoid, tumour.— Besides these forms of limited exostoses, a diffused bony tumour is occasionally met with, in which the whole thickness of the bone for some distance is converted into a lobulated mass of spongy bone, which, in a section of such a tumour that I had the opportunity of examining microscopically, presented the usual structure of bone, but with smaller cavities, and an increased deposit of the granular base.

The specimen (in the Museum of St. George's Hospital, series ii. No. 185) is larger than a man's fist, and involves one side of the lower jaw, from the condyle to near the symphysis. Its innocent nature is clearly proved by the fact that it had been growing for five years without any detriment to the general health, and had been partially removed on a previous occasion without any ill consequences from cutting into the interior of the tumour. On the patient coming under the care of Mr. Tatum, the tumour was completely excised, and with success, as the man was seen in perfect health several years afterwards.[2]

Another still more remarkable case is illustrated by a series of three preparations in the Museum of the College of Surgeons. The history is so interesting that a condensed report of it must be introduced. The thigh was originally amputated on account of a hard and heavy dry osseous substance, surrounding the ends of the femur and tibia, projecting into the knee-joint, extending far up the thigh, and implicating the popliteal artery, vein, and nerve, so as to cause œdema and severe pain (Prep. No. 3244 shown in the accompanying figure). The patient remained well for five years; then another osteoid tumour formed on the stump of the femur, accompanied with severe pain. Amputation was performed higher up. The tumour appeared to grow not from the bone itself so much as from the periosteum, and enclosed the femoral artery (Prep. No. 3245). There was again an interval of health for two years; then a fresh tumour

Fig. 62.—Diffused bony Tumour of the Femur and Tibia: the popliteal vessels and nerve are seen surrounded by the bony growth, the veins varicose from the pressure. The tumour overlaps the fibula, which, however, is not affected. (Museum of the Royal College of Surgeons, No. 3244.)



the knee-joint, there is the more danger of opening the joint, since the presence of the tumour has probably caused numerous attacks of synovitis, which have left the pouch of synovial membrane extending up the thigh permanently enlarged.

[1] Mr. Maunder published (in *Clin. Trans.* vol. xi. p. 59) two cases in which the exostosis was twisted off with strong pliers without any incision. In one the tumour reunited, in the other not. I have tried both this plan and the subcutaneous section of the neck of the tumour.

[2] *Path. Soc. Trans.* 1848-9, p. 95.

formed about the stump, continued to increase upwards, out of reach of operation, and finally killed him, from inflammation and sloughing of its soft coverings, *twenty-five years* after the first appearance of the disease. He had been in good general health during the whole time (Prep. No. 3245, A).[1]

This history presents a remarkable analogy to that of the recurrent fibroid, or fibro-plastic, tumours of soft parts. There are the same leading features, viz. the local malignity of the disease combined with innocence constitutionally, its imperfect imitation of the tissues in which it grows, its constant recurrence near the site of an operation, and, finally, the mode of death—from exhaustion and sloughing after repeated operations, not from infection of the system. The modern custom of classifying such partially or locally malignant tumours as 'sarcoma' along with some of the most malignant diseases of which surgeons have any experience cannot in my opinion be long maintained. I would refer to what I have said on a previous page (317).

Cysts in bone are of two kinds; viz. serous and sanguineous. The serous, or mucous, cysts which occur in the jaws as a consequence of irregularity of the growth, or position, of the teeth will be found treated in a subsequent essay. In such cases the formation of a cyst containing clear fluid is susceptible of an intelligible explanation; but it is difficult to see how simple serous cysts can be developed in other bones, and probably the few cases which are to be found in books rest upon erroneous diagnosis.[2] But cavities containing clear fluid are formed in bones by the growth of hydatids in their interior; and if simple cysts do occur, they would be indistinguishable from hydatid cysts before operation, and would require the same treatment.

Blood-cysts are not of common occurrence, nor is it usually easy to determine their pathological nature. Many of the cases reported under this title appear to have been examples of malignant tumour, in which a cyst has been developed, much exceeding in relative size the solid portion of the growth.[3]

Blood-cysts could only be distinguished from serous or hydatid cysts by puncture. In the great majority of cases they would require complete removal, by amputation if necessary. If the surgeon can satisfy himself of the absence of all soft solid matter around the cyst, he may in rare cases be justified in endeavouring to procure its obliteration by laying it open and stuffing it with lint; but it must be borne in mind that such measures can only do harm if there be anything of a malignant taint about the disease.[4]

Fibrous and fibro-cystic tumour.—Perfect fibrous tumours appear as out-growths from the periosteum; and the most familiar examples of them are the fibrous polypus of the nose, which is treated of in the essay on DISEASES OF THE NOSE, and epulis, which will be found treated of among the DISEASES CONNECTED WITH THE TEETH. In other situations, fibrous tumour could hardly be distinguished from enchondroma before removal, and the diagnosis, even if it could be made, would be quite unimportant. We need not, therefore, give examples of the disease occurring in other parts of the body. Scattered specimens will be found in most of our large museums, and in many of them ossification will be found to have made some progress. In some of these cases the innocent nature of the disease is proved by the history; in others it is an inference from the structure of the tumour. Cal-

[1] Another, and very similar, case may be found in Paget's *Lectures on Surgical Pathology*, vol. ii. p. 506, ed. 1853.

[2] Mr. Stanley (*op. cit.* p. 194) denies the formation of simple cysts in any other bones than those of the jaw.

[3] See a case reported by Mr. Liston, under the name of 'ossified aneurism of the subscapular artery,' *Ed. Med. and Surg. Journ.* vol. xvi. pp. 66, 215. See also Travers's case, *Med. Chir. Trans.* vol. xxi.; and Stanley's, in his *Diseases of Bones*, p. 187.

[4] In Nélaton's *Path. Chir.* vol. ii. p. 48, will be found a striking representation of a large multilocular cystic tumour developed in the femur, and containing bloody fluid. Unfortunately there is no history of this case.

cification occurs in these as in other fibrous tumours (St. George's Hospital Museum, ser. ii. No. 152).

Fibro-cystic tumour of bone is a disease which is little known, and may therefore possibly be of very rare occurrence. It is, however, also possible that this apparent rarity may be due to the fact that most of the examples of this disease have been confounded with malignant tumours. A very interesting account of a growth of this sort connected with the femur, in which the limb was removed at the hip-joint by Mr. J. Adams, will be found in 'Path. Soc. Trans.' vol. v. p. 254, and, appended to the account of this case, a report by Mr. Prescott Hewett on three similar cases, in all of which the femur was the seat of the disease, and in all of which the patient recovered after amputation, and remained well for many years afterwards. There is therefore the strongest reason to believe that the disease was not cancerous. It commenced, in each of the four instances alluded to, in the cancellous tissue of the bone, making its way outwards, infiltrating the shaft, and causing spontaneous fracture; so far, therefore, exactly resembling cancer. It gave the sensation of an elastic substance, with fluid here and there in cavities. There seems to have been no diagnostic mark between it and cancer during life, except the negative indications to be derived from the absence of glandular or constitutional contamination during a somewhat long disease, the duration of the affection being, in the two cases in which that point was noted, three and four years respectively. On examination after removal, the innocent nature of the disease was inferred from the large quantity of firm fibrous tissue of which nearly the whole solid portion of the tumour was formed, the presence only of such cellular elements as are found in growing fibrous structures, and the absence of cancer-juice, or any other indication of a tendency to disintegration in the tumour, or infiltration of neighbouring tissues. Such tumours would now probably be included under the miscellaneous designation of sarcoma.

Entozoa in bone.—A very few words must suffice for the description of the cases of entozoa in the interior of bone. The entozoon appears to have been the ordinary echinococcus in all cases except one quoted by Mr. Stanley, in which the cysticercus telæ cellulosæ is said to have been found in the interior of one of the phalanges. The subject is of no very great practical importance, since it is seldom possible to diagnose the nature of the affection previous to operation. The cases are so rare, that in the great work of Rokitansky [1] only eight are referred to, as the total number which he supposes to have been then observed. A search, however, through the various pathological collections would probably discover many more than these.[2] It is noticed by Rokitansky,[3] that the disease appears often to be directly induced by some injury; but it is difficult to believe that this can be otherwise than accidental. The disease runs a protracted course, and if the shaft of a long bone be the part affected, fracture, spontaneous or accidental, is very probably the first thing noticed. The fracture, in all probability, does not unite; and it has sometimes happened that in an operation, undertaken for the purpose of resecting the ends of the fracture, the hydatid cavity has been exposed and the globular acephalocysts discharged.[4] Amputation is then indicated in ordinary cases; but one is on record, in which the hydatids were scooped out of the cavity of the cyst, which then filled up and a complete cure was obtained.[5] In other cases, the seat of the disease is in a flat bone, as the skull,[6] or ilium,[7] or in the expanded head of one or more of the long bones.[8] These cases are quite within the reach of cure when

[1] *Syd. Soc. Trans.* vol. iii. p. 184.

[2] The Museums of Guy's and St. Thomas's Hospitals contain at least five specimens.

[3] *Loc. cit.* See also the histories of the cases which have furnished the specimens to St. Thomas's Hospital Museum, marked Ser. c. Nos. 230, 253.

[4] Dupuytren, *Leç. orales*, 1839, vol. i. p. 52; St. Thomas's Hospital Museum, Ser. c, No. 230.

[5] Mr. Wickham's case, *London Medical and Physical Journal*, vol. lvii.

[6] Keate, in *Med.-Chir. Trans.* vol. x. St. Thomas's Hospital Museum, c. 6[1].

[7] Stanley, *op. cit.* p. 190.

[8] Coulson, in *Med.-Chir. Trans.* vol. xli. In the specimens of St. Thomas's Hospital

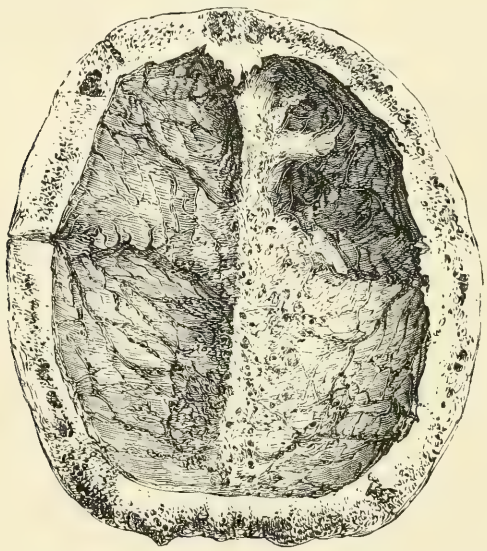
their nature is discovered; and in some rare instances, as in Mr. Coulson's and Mr. Stanley's cases, the discharge of hydatids through a spontaneous opening or a puncture, enables the surgeon to determine the nature of the disease beforehand. Failing this, the symptoms are precisely those of any other cystic tumour of the bone.

The treatment appears to be usually successful. The cyst is to be freely laid open, with the trephine or bone-nippers if necessary; all the hydatids removed, and some caustic [1] applied to the whole interior of the cyst. In most of the recorded cases this has been sufficient; but in Mr. Coulson's case the cure was not completed until after the separation of a small piece of bone from the floor of the cavity, which on examination was found thickly studded on both its surfaces with a great number of minute hydatids.

Hypertrophy and Atrophy of Bone.

The condition of bone usually known by the name of hypertrophy is very generally the consequence of chronic ostitis, and would perhaps be more conveniently

Fig. 63.—Hypertrophy of the Cranium. (Museum of the Royal College of Surgeons, No. 2858.)



designated by some name expressive of its inflammatory origin. Thus, most of the specimens of 'hypertrophied cranium' seen in our museums will be found, if the history be known, to be taken from cases of injury, or to be connected with syphilis or scrofula. The cases also of elongation and thickening of the bones of the leg, related by Mr. Stanley [2] under the head of 'hypertrophy,' appear all of them to fall more naturally under consideration with the sequelæ of inflammation, which have been described above. It appears that this thickening may go on for an indefinite period after the cessation of any symptoms, and that the enlargement of bulk which follows from it is permanent. It is true that in many of the cases of thickening, whether of the skull or of the long bones, which are preserved in pathological collections, no history of injury or inflammatory affection has been obtained; but the exact resemblance of the specimens to those in which such a history does exist,

Museum, c. 253–4, hydatids were found simultaneously in the lower end of the femur and contiguous head of the tibia. Other cases are noticed in the bodies of the vertebræ. Dupuytren, *loc. cit.* Guy's Hospital Museum, No. 1029[30].

[1] Nitrate of silver, lint impregnated with a saturated solution of sulphate of copper ('blue lint,' as it is called at St. George's Hospital), caustic potash, and the actual cautery, have been used.

[2] *Op. cit.* p. 5.

leaves no doubt that most of them are specimens of chronic inflammation. To this inflammatory category of hypertrophy also belong the cases of ostitis deformans (Paget) referred to on page 281.[1] Cases do, however, occur, though so rarely as to be rather matters of curiosity than of practical interest, in which a bone (the skull for the most part) has gone on increasing in size without any symptoms except those produced by its increase in bulk. Such as the well-known instance related by Mr. Prescott Hewett, in his lectures at the Royal College of Surgeons, in which a man's skull continued to increase in size from year to year, with no symptoms whatever, so that he was only aware of the fact from the increasing size of his hat (fig. 63). The disease, however, in this case was clearly traced to an injury. As no symptoms can be attached to such cases, no treatment is known to have any influence upon them. In the absence of any constitutional affection, the persevering use of counter-irritation, by iodine or blistering, would appear to hold out most hopes of checking the growth.

Atrophy of bone is a more frequent and a more important disease than the opposite condition of hypertrophy. Inflammation, fatty degeneration, disuse, and injury are frequent causes of atrophy; and there is also a simple atrophy, in which the composition of the bone is unaltered, and in which no obvious cause is present (unless it may be the general failure of nutrition in advanced life), and where the amount of bony tissue becomes gradually less and less, until the bone is no longer strong enough to resist slight violence.[2] As a consequence of senile change, or fatty degeneration, atrophy is one of the most common causes of spontaneous fracture. It may also occur in any bone, to some extent, as a consequence of confinement during a lingering disease.[3] Brodie says,[4] 'All bones in a state of inaction lose a great part of their phosphate of lime. After compound fracture, when the patient has been long confined, the bones in some instances become as soft as a scrofulous bone, so that you may cut them with a knife.' The cases which are spoken of under the name of 'fragilitas ossium' appear to belong for the most part to the class of fatty or senile atrophy. Injury sustained in fracture is also a frequent cause of atrophy. Mr. Curling[5] believes that the cause of atrophy after fracture may often, if not always, be found in injury to the medullary artery. Even allowing, however, that this explanation is plausible in some cases, there are others where it cannot apply. Such are cases of atrophy of both fragments, or of the bone in the neighbourhood of the fragments, while the latter are not so much atrophied.[6] Atrophy from inflammation is a condition illustrated by many morbid preparations, though it does not attract much attention in practice. It is merely the persistence of that degenerative change which leads to inflammatory softening; and probably many of the cases of atrophy after fracture should be referred to this head. Extreme instances of this atrophy after fracture are referred to on page 293.

Connected with atrophy is the suspension of growth, occasionally, though rarely met with, in which the epiphyses remain separate from the shaft of the bone; and it seems probable that injury to the epiphysial cartilage, in separations of the epiphysis, may occasionally give rise to shortening of the bone from suspension of growth between the shaft and epiphysis.[7]

Atrophy of bone is an affection which does not appear to be marked by any

[1] In the very interesting paper to which reference was made under the head of Mollities Ossium (p. 313), Mr. Durham divides cases of hypertrophy of the cranial bones into two classes, those which are light, crumbly, and porous, somewhat resembling mortar, which he calls porous hyperostosis or osteoporosis, and those which are hard, dense and heavy, which he denominates sclerotic hyperostosis. The former he believes to be instances of cured or arrested mollities, the latter the sequelæ of rickets. I must refer the reader to the original.

[2] Humphry, *On the Skeleton*, p. 8.

[3] See a preparation, No. 384, in the Museum of the Royal College of Surgeons, with its history.

[4] *Lect. on Pathology*, p. 409.

[5] *Med.-Chir. Trans.* vol. xx.

[6] See a preparation in St. Thomas's Hospital Museum, Series c, No. 2. Here the atrophy is most marked in the *upper* part of the shaft; and the fragments included between the fractures (which were triple) are thicker than either of the portions of the shaft.

[7] Holmes, *Surgical Treatment of Diseases of Infancy and Childhood*, 2nd ed. p. 238.

peculiar symptoms, or to admit of any special treatment. After injury to any part, the restoration of moderate functional activity as soon as it can prudently be recommended, the avoidance of any cause of pressure on the main vessels or those of the surface, and the choice of a suitable posture, with attention to the general health and nutrition, are the objects of a judicious treatment, irrespective of the condition of any particular part; and these measures are all that could be suggested to avert atrophy of the bone, even if it were known to be impending.

Spontaneous fracture has been mentioned repeatedly in the previous pages, in connection with several morbid states, which may be thus enumerated in the order of their presumed frequency as causes of fracture: viz. senile atrophy, malignant disease, tumours of other kinds, including hydatids; disorders of nutrition depending on disease of the spinal cord;[1] the ulceration which accompanies necrosis, and, lastly, other kinds of ulceration. But besides these, cases of spontaneous fracture occur without known cause; sometimes in making a violent muscular effort, as in throwing a stone, or striking a blow; at other times in the most ordinary action, as in turning in bed, quiet walking, &c. Those which are caused by violent muscular efforts too nearly resemble the ordinary cases of fracture (particularly fractures of the patella) to call for any remark here; and the treatment of the fracture in the cases which occur during the progress of known disease is a matter usually of subordinate importance, and has been already sufficiently discussed in treating of the disease. I would merely add, that when the long bones are perforated by ulceration occurring around a sequestrum, the question of amputating the limb, or attempting to save it, will demand much care, and that, as a general rule, amputation will not be required in the upper extremity, nor should it be performed in the spontaneous fracture which rather frequently follows acute necrosis in children, unless the general health is evidently giving way; but in other cases of necrosis of the bones of the lower limb, and in almost all cases of ulceration not due to the separation of a large sequestrum, amputation as a general rule is indicated. When fracture occurs during the ordinary muscular exertions of everyday life,[2] and in persons not known to labour under any disease, various remote causes have been imagined, but none have been proved to be really efficient. The one most commonly admitted is syphilis; but, not to dwell on the fact that the accident has occurred in many persons in whom the strongest reason existed for believing that no such taint was present, all that we know of the action of syphilis on the bones tends to show that (apart from ulceration and the separation of necrosed portions) it renders them not more but less brittle. The practical point of chief interest connected with such cases is, that there is no reason to despair of union, and that they should be treated in the ordinary way, with perhaps more than the ordinary care to avoid constriction of the soft parts.

Wounds of bone.—It is not necessary here to dwell upon wounds of bone, since the reader will find all that is practically important in the essays on Fractures, Gun-shot Wounds, and Injuries of the Head. Cases of incised wounds of bone without fracture do, it is true, occasionally come under the notice of the surgeon. The chief interest in such injuries lies in the probability of diffuse suppuration (osteo-myelitis) supervening, or of the separation of the periosteum, which is a common event in such cases, leading to necrosis. A reference to those sections will illustrate sufficiently the prognosis and treatment.

T. Holmes.

[1] See Charcot, 'Lectures on Diseases of the Nervous System,' *New Syd. Soc. Trans.* vol. ii. p. 315.

[2] Some interesting cases are to be found in Robert, *Conf. de Clinique Chir.* 1861; and many are scattered about in various books and periodicals. I remember seeing at St. George's Hospital, a stout, florid young man who had fractured his thigh in simply walking across his room, without catching his foot or making a false step. It healed like any other fracture.

DISEASES OF THE JOINTS.

IN a sketch such as the present, which must necessarily be brief, any consideration of the diseases of joints in minute detail would be impossible. The writer's aim, therefore, will rather be to present the subject in its broader outlines. It will be divided into two parts.

1. The general pathology, symptomatology, diagnosis, treatment and prognosis of the diseases common to the structures of which joints generally are made up.

2. Their clinical features, as they are found in particular articulations.

These diseases, the result usually of one or other form of inflammation, are of considerable variety, affecting as they do such very different structures as synovial membrane, cartilage, bone and ligament. But, though each of these structures may be the starting-point of morbid processes, it is extremely rare for one bone to be extensively affected without the others becoming involved to a certain extent. Again, each is not affected with the same degree of frequency, far from this. For instance, disease hardly ever begins *primarily* in cartilage or ligament. Of these, the first is non-vascular, and its functions are of a purely passive kind; the same almost may be said of the second. Consequently they are far less liable to inflammatory affections than either the synovial membrane or bone, which are both very vascular and possess very active functions. This is why amphi-arthrodial joints are so rarely attacked by disease as compared with the di-arthrodial. They have but a rudimentary synovial membrane (Luschka[1]) and their functions, as well as those of the bones around them, are of a more passive kind. In short, it may be taken as generally true, and this it is well to bear in mind, that the liability to inflammatory disease or neoplastic change of any tissue is in direct proportion to its original physiological functional activity.

The causes, too, which operate in producing these diseases are very various. They may be local or constitutional, or one of these modified by the other. Among the first we find injury, *i.e.* blows, strains, crushes, cuts, punctures, &c., then over-exertion or exposure to extremes of heat and cold. Among the latter we meet conditions which modify the vital processes in all the tissues of the body, but which are many of them particularly prone to produce evil consequences in those of the joints. Some of these are often spoken of as the diathetic joint affections, *i.e.* such as are due to the so-called scrofulous or strumous, the rheumatic and gouty diatheses; while others are set down as produced by the action of certain specific poisons introduced into the system—namely, those met with in pyæmia, syphilis, gonorrhœa, scarlatina, typhoid fevers and some forms of kidney disease. The tendency, however, now-a-days is to abandon the rather vague term diathesis, and to speak of all the constitutional disorders in question as due to the presence in the blood of definite poisons, which either by over-stimulating the tissues of the joints, or by lowering their vitality, bring about the changes in them with which we are familiar. Thus the scrofulous diathesis is now believed by many competent pathologists to be due to the presence in the economy of certain microbia and their products (Billroth, Hueter, Schuller; see CARIES OF THE SPINE). Gouty changes in tissues, on the other hand, are demonstrated to be dependent on the existence in them of a chemical irritant, urate of soda. Chronic rheumatic affections are believed by some to be of an analogous nature. Of the exact *materies morbi* of syphilis we know little or nothing at present, but its

[1] *Die Halbgelenke des mensch. Körpers*, Berlin, 1858. Quoted by Hueter, *l.c.*

fairly uniform effects upon the system show it to be a very definite agent. With the actual toxic principle present in the conditions known as pyæmia and septicæmia we are but scantily acquainted as yet; but, as far as we know anything of the nature of the disease from clinical study and experiment, it seems fair to assume that it is caused by some definite poison produced during the process of putrefaction, probably the product of microbia in the blood. Of the remaining affections, viz. those met with in gonorrhœa, acute rheumatism, scarlatina, and some renal affections, it need only be said that pathologists are more and more inclined to regard them as due merely to varieties of the pyæmic condition, and differing from what are found specially to follow the well-known infection of surgical wounds only in degree of severity. It is suggested that, if these last diseases are produced by organisms in the blood, the variety observed among them may be due to microbia having been cultivated in each case upon a different soil, and so having developed individual peculiarities. (See Pyæmia, vol. i.)

Affections of the Synovial Membrane.

Beginning now with the diathrodial joints, as of greater importance and more liable to disease, we shall first consider the affections of the most physiologically active of all their component structures, consequently that most frequently the seat of disease, the synovial membrane.

Of the morbid processes to which this is liable, nearly all come under the heading of inflammation. And here we find every gradation between transient hyperæmia, with trifling hypersecretion, and intense congestion with suppuration. Three forms, however, are generally spoken of—(1) the acute, (2) the sub-acute, (3) the chronic—all arising from a variety of causes, local or general.

It will be convenient to examine the disease in its simplest forms, first as caused by local influences and independently of any constitutional condition. This will give the type of synovial inflammation, and we need afterwards study the more complicated affections due to constitutional causes only so far as they depart from this type.

The simplest forms of *acute synovitis* are those which follow such injuries as blows, strains, and crushes not opening the joint. With those injuries which open the synovial sac, even by puncture, an extra factor operates in many cases—namely, the introduction locally of septic matter, which modifies the morbid process in a most important way (see pp. 335 and 349). Next to these causes come exposure to extremes of cold or heat, or to wetting.

The vaso-motor disturbance induced by any of these results in rapid dilatation of the vessels of the synovial membrane, with consequent increase in its functional activity, is evidenced by the free hypersecretion of synovial fluid. A joint examined in this condition presents a remarkable appearance on its internal surface. The membrane is of a bright red colour, uniformly or in patches, contrasting markedly with the pearly white of the encrusting cartilages. It is swollen throughout, right up to the border of the latter. The fluid now distending the joint will vary in quantity and quality according to the intensity of the vascular excitement in the membrane. If the latter is moderate, it will present the appearance of ordinary but superabundant synovium. A little later and this fluid is diluted with more or less serum, with a few leucocytes, until finally, in the worst attacks of active congestion, the latter are present in sufficient number to constitute true pus. There is no sharp boundary line between these three conditions, either pathological or clinical; they run into one another.

In the simplest forms of acute synovitis, however, it is the rule to find little more than turbidity of the superabundant synovium, hardly sufficient to justify its being called semipurulent. It may contain a few flakes of fibrin and perhaps a shred or two of cast-off lining of the joint.

The symptoms of this condition will be (subjective) pain on movement or handling of the part; local heat and throbbing, with perhaps slight general pyrexia: (objective) distension and fluctuations, with slight redness and altered position.

The general treatment in this state is usually simple. Rest for the joint affected comes first, and must be secured either by position, splints, or other appliances (see special joints). Local antiphlogistics come next, *i.e.* leeches or wet cupping in the case of strong healthy individuals, followed by ice or evaporating lotions to the part in the earliest stages, or hot belladonna fomentations a little later on.[1] The constitutional treatment will consist at the same time of a brisk saline purge, with the addition even of a little antimony in sthenic cases, while in the weak or debilitated tonics and stimulants are often indicated. In a few instances anodynes and sedatives are called for where there is much pain and general systemic disturbance. If there be any suspicion of general septic origin of the attack, quinine or the salicylates should be freely given, together with stimulants.

Under such treatment simple cases do well, and the prognosis is favourable. The hyperæmia becomes less and less, effusion ceases, tension is relieved, and, with the pain, tenderness and local heat, the general pyrexia also disappears. The turbid synovial collection will then be absorbed, and a more or less complete *restitutio ad integrum* take place. Sometimes, however, this absorption is slow, and long after all heat, pain, and redness have disappeared, a serous fluid may still remain behind in large quantity and distend and weaken the joint. This condition, known as *hydrops articuli*, is, however, more likely to follow the sub-acute or chronic affections (see pp. 336–337).

Here it will be necessary to use repeated blistering or, better still, aspiration of the joint with a very fine needle, the utmost precautions as to cleansing the latter and the skin perfectly having been observed. When the fluid has been thus dispersed, the capsular structures so long stretched will require support for a time. This is best given them by careful strapping in the first instance, and later on by elastic web coverings. After this, if there be any stiffness from the adhesion of patches of plastic matter in or about the joint, this may be got rid of by passive movement, which, if painful, may require an anæsthetic. The final absorption of any remains of this plastic matter may be much aided by inunctions of mercurial or iodine ointments, and by friction. Any little weakness left after this will soon be recovered from, as the joint is used, especially if the latter undergo regular douching with cold water (preferably salt), with shampooing.

Such would be the history of a case of simple acute synovitis going as far as effusion of a turbid serous synovium and terminating favourably within a short time. If, however, the inflammation run higher until true pus is rapidly formed, we shall have, in addition to all the subjective and objective symptoms, in a marked degree, above described, several others which will serve to indicate the state of the interior of the joint. Firstly, a rigor is very commonly observed at the commencement of suppuration, then œdema of the part already reddened. If the disease run on, the skin will soon lose its bright red tint, and become of a dusky brownish red, with earthy tracts, until in extreme cases one spot in particular becomes purplish, thinned, and eventually bursts, discharging the contents of the joint. By this time the surfaces of the latter will have assumed a somewhat different aspect to that described above. The synovial membrane will have become more deeply congested and swollen, it will be softened, pulpy and ulcerated, and overlap the encrusting cartilages, causing changes in them, to be alluded to presently (see p. 349).

The treatment of this form of simple synovitis where pus is forming is based upon general principles. The first thing is to empty the joint. This is best done by aspiration or incision. In either case the utmost care must be taken to keep the parts aseptic by careful cleansing of the skin and needle in the first instance and by the use of strict antiseptic dressings (Listerian or other) in the last. The incision should be made on the inner aspect of the joint in the long axis of the limb, but well back, so as to drain the deeper part of the cavity. (R. Parker.) After the latter has been emptied, it may be washed out with $2\frac{1}{2}$ per cent. carbolic solu-

[1] Extr. Bellad. mixed with an equal amount of glycerine is perhaps the most convenient form in which to use this drug. It may thus be easily and gently spread over the tender part, and will relieve pain as well as lower the inflammation.

tion, prior to the adjustment of drain-tubes, and to being enveloped in the absorbent dressings. These latter must be re-applied until the suppuration has ceased and the wound of the joint cavity has closed. When the part has quite cicatrised, the functions of the joint may be completely restored, after an interval of stiffness, if the drainage have been carefully conducted at an early stage. If, however, this opening up of the joint can be avoided, it will be all the better, and, fortunately, a few carefully repeated aspirations are often quite adequate to meet all the exigencies of the case.

During the formation of the pus, and its arrest afterwards, the constitutional treatment will usually require to be a tonic one in the class of cases met with in metropolitan practice, and stimulants will often be needed. In sthenic cases in the country, saline purging, and even bleeding, sometimes may be resorted to with advantage at the outset, but always cautiously, in view of the after condition of the patient. But where, in spite of all antiseptic precautions, the pus within the joint has become contaminated by some ferment from without, every form of general sustaining treatment will be required. Here we shall have the greatest difficulty in saving the joint or limb, if such be the seat of the disease; and not infrequently we are obliged to sacrifice one or the other to save the patient's life. For, in such cases, where the suppuration in the joint becomes foul, the septic fever is usually very high, and the strain upon the patient's powers peculiarly great.

Sub-acute synovitis is produced by the same causes as above which lead to the acute form, but operating in a milder degree. There is consequently less marked hyperæmia of the synovial membrane and less rapid secretion of fluid. The latter consists here of little more than synovium, diluted with a certain proportion of serum, but still quite clear, and containing few or no corpuscular elements. The local heat is only slightly raised, redness and general pyrexia are absent, and the joint is not tensely distended. Pain and tenderness are almost absent, and the part feels little more than stiff. An examination of the surfaces of the articulation shows little departure from the normal, except perhaps slight hyperæmia of the lining membrane in patches.

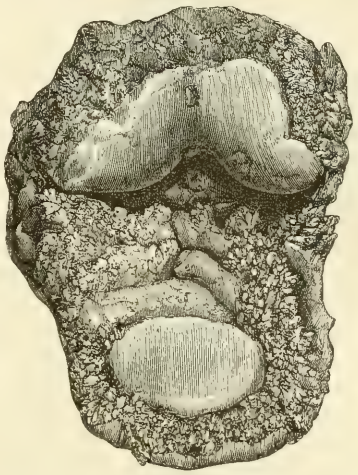
The treatment in this case will be much the same as in the acute inflammation, but need not be quite so vigorous at first. The chief difficulty here will be, as a rule, to restore the balance between absorption and secretion in the joint, which leads to accumulation of fluid in the joint, usually spoken of as *hydrops articuli*. This condition is more likely to be troublesome now than after the acute affection. If the clear fluid be removed from the joint by blisters or aspiration, it is very apt to re-accumulate over and over again, even without any re-accession of inflammation. It is in this state that, if repeated blisters and aspiration have failed, the injection into the joint of some mildly stimulating fluid, which is at the same time perfectly aseptic, is found of use. The best materials for this purpose are a $2\frac{1}{2}$ per cent. carbolic acid solution or tincture of iodine of the strength of a drachm to the ounce of pure water. The effect of using either of these is, first, to produce a mild inflammation of the synovial membrane, with heat, and refilling of the joint emptied at the time of the operation, and then such a modification of the processes of secretion and absorption as to re-adjust their balance. How this is actually brought about is, perhaps, not as clear as it might be. After these sub-acute attacks, the use of elastic web coverings is often necessary for long periods.

Chronic simple synovitis differs little from the last except in degree. The same causes operate, the same effects are produced. But, owing to some peculiarity in the individual, the latter last longer, and are in consequence somewhat modified. Thus, though the fluid accumulation and the hyperæmia differ in few respects from what is observed in the sub-acute form of disease, the persistence of the latter for long periods leads to plastic thickening of the synovial membrane. It thus becomes altered in consistence, being toughened and heavy, and often irregularly hypertrophied in all its parts. If its borders are particularly affected, pendulous masses of thickened tissue are sometimes formed which hang loose about the sides in the joint (fig. 64). Should one of these become fixed during the movements of the latter, its pedicle may

be torn through, on which it becomes free to move in all directions, and often gives much trouble (see p. 355). Usually with the chronic form of synovitis there is a certain amount of participation of the ligamentous structures around; but this we shall consider later on.

The symptoms of this affection are almost the same as those present in the sub-acute form, only differing in being less marked. Indeed it would not be necessary to consider these two as distinct varieties were it not that the plastic changes in the membrane are important as requiring careful treatment, being prone to very seriously affect the functions of the joint if neglected. In addition, then, to the treatment suitable in sub-acute cases, we have to aim at causing absorption of the plastic matter deposited. This is best done by the combination of pressure by means of strapping with frictions, and the inunction of mercurial ointment, or painting the part with tincture of iodine. The joint should be kept at rest during this treatment, and passive motion should precede for some time the permission to use it. When it is made use of, it should be supported by strapping or elastic bandages for a considerable time, until all tendency to the reproduction of the *hydrops articuli* has passed and the part feels quite strong. Douching with sea water and *massage* will also be of use here, combined with the best tonic constitutional treatment we can devise for each patient. If not otherwise contra-indicated, the patient should take outdoor exercise from an early date, the affected joint being carefully protected from movement or strain by some suitable appliance (see special part). Sea-air and sea-bathing are also particularly useful here.

FIG. 64.—Pendulous Growths from the Synovial Membrane. (From a preparation in the Museum of St. George's Hospital.)



Bearing these three kinds of synovitis produced solely by external causes in our minds as types of simple inflammations of the synovial membrane, we turn now to the consideration of those forms due to constitutional causes. Here the morbid influence acts from within either quite independently of any external agent, or, the latter being present, so modifies its effects as wholly to alter the character of the process it has started.

Under this heading will come the following affections of the synovial tissues—the pyæmic, scarlatinal, puerperal, the gonorrhœal, polyarthritic rheumatic, and those of typhoid, small-pox, and dysentery; the nephritic, the so-called strumous, and syphilitic, the gouty and chronic rheumatic.

This long list of varieties commonly spoken of may be much shortened if we adopt the view now held by many, that affections of the joints following on putrid changes in ordinary wounds, and those met with in scarlatina and puerperal fever, are really one and the same in kind, the ulceration of the throat in the former, and the foul state of the uterine surface in the latter, being the starting-point in this case. These may then be considered under the common heading of acute pyæmic synovitis. Again, that those often accompanying typhoid fever, small-pox, dysentery, gonorrhœa, some forms of Bright's disease, and that known as polyarthritic or acute rheumatism, are closely allied to the latter, except in being usually less destructive, and may be held to be due to a form of sub-acute pyæmia. Some, again, would go a step further, and regard the gouty and so-called chronic rheumatic affection as both due to one poison, or to two poisons closely allied: but this perhaps with less reason. That a definite toxic agent is present, however, in large quantity in the blood in gout we know positively, and that the liability to inflammation here is in direct proportion to the amount of this in the tissues, is also almost beyond question.

This leads us to speculate upon the causes of the other affections of our list. And when we do so in the light of the accurate clinical observation of the present day, and of experimental research, we are driven more and more towards the conclusion, that with *perhaps* the exception of the rheumatic arthritis, they are all due to the presence of definite poisons in the blood, which in some cases act by irritating or over-stimulating the tissues through which they are carried, and in others by so interfering with the nutrition of the latter as to cause degenerative changes. What these poisons are in each case we do not definitely know as yet, but about some of them a good deal has been ascertained. That of gout, for instance, we can separate chemically from the tissues, and find it to be urate of soda ; that of syphilis we only know through its common mode of introduction into the system and fairly uniform effects, and the influence over it of certain drugs ; that of the pyæmic group appears from daily accumulating evidence to consist either in the presence in the blood of certain microbia or some toxic matter produced by them ; finally, the excitant of strumous inflammations, it is believed by many competent pathologists, may be almost proved to consist also of lower organisms or their products acting in this case with less energy. (See Caries of Spine.)

Another point strikes us here in looking over the list of synovial diseases above enumerated—namely, that they arrange themselves easily into three groups, according to the character of the processes which underlie the grosser changes present. One group, including the above acute and sub-acute pyæmic affections, is generally characterised by the presence of active hyperæmia, rapid effusion, and cell-proliferation. The next, made up of the strumous and syphilitic by a more passive hyperæmia and sluggish cell-proliferation. The last, including the gouty and chronic rheumatic, rather by degenerative changes, accompanied or followed by passive hyperæmias of usually moderate intensity, and not marked primarily by either excessive effusion or cell-proliferation. The varieties of disease in each of these groups display a close parallelism in their natural history. For instance, it requires minute scrutiny indeed to detect differences between the chronic pulpy degeneration of the synovial membrane, due to so-called scrofula, and the analogous changes of the structure due to syphilis. The same may be said of the other affections of the joints enumerated above as belonging to the acute and sub-acute pyæmic class, while between the primary degenerative changes of gout and chronic rheumatic arthritis there often seems to be a close relation.

With these few general remarks on the synovial affections depending upon constitutional causes, we pass to their more particular study, arranging them in groups for convenience sake according to the above sketch.

Acute pyæmic synovitis is met with, as already noted, in the course of several diseases hitherto held to be quite distinct. It is probable, however, that the poison which produces it is of the same nature in each case, and is introduced into the system in the same way generally in all—namely, through foul suppurating surfaces, whether these be the result of surgical injuries or operations, of contamination of the raw uterine cavity after parturition, or of the scarlatinal inflammation of the throat, ear, or other mucous tracts (for details see Pyæmia, vol. i.) This agent once entered in sufficient amount seems to possess the power of increasing rapidly to a degree sufficient to produce intoxication of the whole system. This is indicated by an abrupt rise of temperature, culminating in a rigor, after which the temperature may as suddenly fall again. At any time after this one or more of the joints may commence to swell quickly, as a consequence of effusion into them, which, as in the *simple* affection, may be synovial, serous, or purulent.

It is only necessary now to point out briefly how this septic synovitis differs from the typical simple affection described already (pp. 334, 335.) First it may appear in several joints at once, or develop rapidly in one and as quickly subside, while commencing in another perhaps on the opposite side of the body. It is often accompanied by circumscribed pink blushes, which contrast markedly with the pale faded look of the rest of the skin, due to the constitutional conditions, and quite unlike the diffused bright blush of ordinary synovitis. Its effusion in bad cases tends to rupture the synovial

sac early, and to extravasate itself among the peri-articular structures. The affection is rarely limited to the synovial membrane alone, but tends to extend rapidly to the encrusting cartilages, which are evenly and smoothly removed by a process more like digestion than anything else, and usually quite unlike ulceration (see p. 349). This change, too, in the cartilage is not necessarily accompanied by startings of the limb, as in other cases.

The subjective symptoms here are the same as those present in the simple affection running on to suppuration (see pp. 334, 335) and need not be further alluded to. But the constitutional condition is quite different in this case. Here we have all the general disturbances peculiar to the pyæmic state in greater or less degree: the high but fluctuating temperature, the rigors, delirium, restlessness, &c., for the detailed consideration of which the reader is referred to the essay on PYÆMIA.

As to the ætiology of the local affection, we have started with the justifiable assumption that it is due to a poison circulating in the blood, and there only remains to be considered how this produces the inflammation of the synovial membrane. The most satisfactory theory to account for this appears to be briefly the following. That the septic matter in the circulation acts as an irritant upon all the vascular structures of the body. That all are thereby excited to increased function for the time being. That those of them which preside over the secretion of the various fluids of the body give evidence of this in the increased amount they produce. Thus, for instance, the intestine may give off much mucus; the lung likewise in the case of the enteritis or bronchitis so frequently observed in typical pyæmia. But in both these and other instances, the secretion containing some of the poison from the blood is cast out of the system. In the case of the synovial cavities, however, this is not so. Their secretions are thrown off into a closed sac, from which there is no escape except by absorption. But the fluid in this case contains a poison eliminated from the blood, as offending material, and is therefore a strong local irritant. We have, therefore, not only the original stimulus to inflammation of the synovial membrane, due to the poison in the blood, but this plus the active irritant of the septic synovium, pent up and ever increasing in the joint. It is probably for this reason that we find free effusions into synovial cavities in septic conditions of the system where the poison is not present in sufficient amount to produce very marked outpourings of secretion from free surfaces (*e.g.* intestine, lung), where there is no accumulation of the *materies morbi* for any time. With the varying virulence of the poison, too, there will be a difference in the intensity of the inflammation in the joint, and we may find a simple synovial, a serous, or a purulent effusion into it. The last of these, charged with septic matter (whatsoever this be), now acts as an intense irritant upon the cartilage, causing rapid proliferation of its cells and solution of the matrix in a way to be described hereafter (see pp. 349–350).

The diagnosis of these affections is rarely difficult in view of the general condition, and requires no special notice.

The local treatment, too, is conducted on the same principles laid down for the simple affection; the necessity for early evacuation of the septic effusion from the joint by aspiration or incision being particularly urgent here (see p. 335). In addition, we have to employ those measures for dealing with the general condition mentioned in the essay on PYÆMIA. Our chief reliance here will be upon quinine in large doses, combined with the free use of the stronger stimulants.

The prognosis in acute cases is gloomy, both as regards the joint and the life of the patient. Where the septic irritant is present in sufficient amount to cause free suppuration in the articulation, as is often the case, it is only too likely to be abundant enough to produce fatal general toxic effects upon the system too. But where the poison is less virulent, or the patient strong enough to resist it, there may be recovery after more or less disorganisation of the joint, followed by anchylosis.

In the synovitis often accompanying gonorrhœa, typhoid fever, small-pox, dysentery, the so-called poly-arthritic rheumatism, and some forms of renal disease, we have but milder forms of the affection just considered. Either the dose of the poison in these cases is smaller, or it is less virulent, or the patient's vitality is greater: the

results, therefore, are not so bad in most cases. This is not always so, however. Fatal pyæmia has been known to follow gonorrhœa in several cases.[1] I have also had to treat a case in which, during typhoid fever, rapid effusion into the right hip-joint had gone on to softening of the capsule, and slipping out of the head of the femur upon the dorsum ilii, from which I was able to reduce it again into the acetabulum. But in the majority of cases, the form of synovitis following the diseases mentioned above is of a milder character than that of the first class. How the septic matter is introduced in each case is not always certain. But we can readily understand the possibility of its reception from the inflamed or ulcerated urethra, from ulcers in the intestine, or pustules on the skin, &c. I am also inclined to think, from numerous observations, that suppuration of the middle ear is a more frequent source of septic intoxication than is commonly supposed, and is often overlooked in such cases. I have seen poly-arthritic synovitis traceable to nothing if not to *otitis media purulenta*.

In this group of sub-acute septic synovitis, the temperature usually rises very considerably, often four or five degrees, but does not oscillate so much as in the first group; rigors, too, are not so frequently observed. The inflammation of the joint is not so rapid in its course, and often produces but slight effusion, with puffiness, and a faint blush which soon fades. The pain is usually very severe, perhaps more so than in the severer cases, but it is rather on movement than from distension, &c. Here, too, there is the same tendency as in the first group for the disease to affect one synovial tract after another, or several at a time, none in the body having immunity, not even the tendinous sheaths and bursæ. The possibility of the smaller 'out of the way' joints being affected in this way should always be borne in mind as explaining, perhaps, many of those deep-seated pains and swellings occurring in the course of the diseases enumerated above, in situations in which we are not familiar with synovitis. Thus any of the small articulations of the vertebral column may be affected as well as bursæ to whose existence even our attention would otherwise hardly ever be called.

In *gonorrhœa*, the joint affection generally starts about the second or third week after the appearance of the purulent discharge, but there is no great regularity in this matter. In the other diseases, it may start at any time during their existence; that is, as long as they are accompanied by suppurating surfaces which present a suitable soil for the reception of the accidental inoculation. In all the affections of the sub-acute specific group, but perhaps especially in that following gonorrhœal urethritis, the synovitis leaves the joint in a condition in which recurrence of passive effusion is frequent: it appears, too, to remain longer painful than after the simple affections. It may also degenerate into the chronic form, with much plastic exudation both in the synovial membrane and in the parts around, leading to much stiffness of the part.

The diagnosis of the nature of the synovial affections of this group is not difficult, if we bear in mind the possible constitutional causes alluded to.

The treatment, too, apart from the cleansing, if possible, of the original focus of absorption, and correcting the general septic condition, offers no material points of difference from that described as suitable in the *simple* form of subacute synovitis (see p. 336).

We turn now to that group of so-called constitutional synovial affections characterised in the main as we have seen (p. 338) by a more passive hyperæmia, and sluggish cell-proliferation. This group will include *syphilitic* and *strumous* synovitis.

It is necessary to remark, however, that we are not including here that form of sub-acute synovitis often noticed early in the secondary stage of syphilis, which differs little, if at all, from what we have been considering under the head of sub-acute septic synovitis. The congestion and hypersecretion here in the joints are analogous to what is often observed at the same time in the mucous membrane of the throat, larynx, and bronchi, at the outset of the secondary sequelæ, which last for a short

[1] Wilks and Moxon, *Path. Anat.* 2nd ed. p. 70.

period, and disappear spontaneously, but only to be followed soon by the more obvious cutaneous syphilides. The synovitis here is probably due to the irritation of the poison, which as yet is not sufficiently developed to produce those plastic tissue changes familiar to us in the later secondary and tertiary stages. It is probably this milder form of synovial affection, without marked effusion, which gives rise to those 'prodromal pains' in the joints and deeper parts of the back so often met with at the outset of syphilis. Possibly the joints of the spine are the seat of some of them, as well as those larger articulations which we can see and which are usually the seat of pains too.

But the syphilitic synovitis which is here grouped with the strumous is not this. It is that slow structural change in the synovial membrane coming on late in the disease, whether acquired or congenital. For in the latter form it occurs quite as often, if not more so, than in the former. Any or every structure of a joint may be affected, but the bulk of the disease is generally observed in the soft parts, especially the synovial tissues. Here we are dealing with a small-celled infiltration, usually most abundant in the latter. To the naked eye, its appearance differs but little, if at all, from the granulation-tissue of the chronic strumous affection. When the cells are aggregated in distinct masses, we have the true gumma before us. But usually it is distributed evenly like inflammatory exudation (although there is but slight hyperæmia present, and that of a sluggish, passive character), throughout the whole synovial tissues, giving the latter a softened pulpy consistence, and a swollen appearance. In this condition it may remain for a long time, if not removed by treatment, or may undergo further secondary changes. The latter will be quite analogous to what takes place in the pulpy granulation of struma. It may become converted into fibrous tissue, or may liquefy, caseate, or become converted into cretaceous matter. Thus, as we shall presently see, there is in both syphilis and struma either (1) a return to the healthy state, with or without permanent thickening; (2) liquefaction of the lowly-organised granulation-tissue and the formation of larger or smaller collections of soft broken-down material which may burst its way through the skin or into the joint; (3) the conversion of this same tissue by a process of fatty degeneration into cheesy masses in the neighbourhood of the latter, or (4) its drying up into cretaceous matter in the same situation. If the deposit be present in the actually granulating form, it will, if it break down, usually follow the rule which applies to external gummata elsewhere—namely, progress more or less rapidly towards the surface of the body, and open eventually upon it. It may then, however, degenerate progressively towards its base, until it secondarily opens into the joint (see Coulson's case[1]). This, too, shows a close parallel with the strumous affection. Sometimes, but not as a rule, this tertiary deposit in the synovial structures provokes an effusion into the joint.

These tertiary syphilitic lesions have been long recognised clinically, but Lancereaux[2] was one of the first to demonstrate the condition by post-mortem examination. In his interesting description the clearest proof is given that the tertiary deposits or inflammatory products in the articular structures present the same characters and undergo the same changes as elsewhere in the body, as indeed we might expect.

As to hereditary syphilitic disease of the synovial structures, recent observations tend to show that the same condition may be expected to, and does, appear here as in the late tertiary acquired form. There is much need, however, of further careful study of this point.

The subjective symptoms of this late syphilitic affection of the synovial structures are usually not well marked. There may be very extensive invasion before either much pain, weakness, or stiffness are complained of, and a patient will often continue to use the part when an amount of swelling, &c. is present, which, were the disease strumous, would indicate very extensive and disabling destruction, and be accompanied by considerable suffering. The objective symptoms are: swelling, usually far less uniform than in the strumous affection, and possibly localised at one or two

[1] *Lancet*, vol. i. 1858. [2] 'Des Arthrites Syphilitiques,' *L'Union Méd.* 1873, No. 88.

spots into lumps which may have the elastic or doughy feel of fresh or degenerating gummata respectively. At the same time there will be little or no rise of local temperature, or other signs of active congestion. The colour, too, will be unchanged, unless any gummatous deposit is approaching the surface, or have broken through the latter, when the well-known brownish-purple lividity will be marked at that spot, contrasting notably with the usual earthy tone of the rest of the surface, so often seen in late syphilis. The diagnosis is also much helped if there be in other parts of the body evidences of the disease in one or other of its numerous forms. When the affection is congenital, some of these may be, as I have seen, interstitial keratitis and the 'pegged teeth' so often found with this disease.

The treatment of this form of joint disease is usually more satisfactory than that of the strumous variety, unless it have advanced to such an extreme degree as in Lancereaux's case, and be accompanied by such a hopeless cachexia. Our chief reliance with younger individuals will be on alternative doses of mercury: under its use, combined with rest, change of air, cod-liver oil, tonics, and careful dieting, the symptoms will often rapidly disappear. Among the more aged and cachectic, iodide of potassium, in doses increasing daily if necessary to as much as a drachm three times a day, in largely diluted solution, is preferable to mercury, the same tonic treatment being used in both. Where complete restoration of the joint takes place, it may be marked on its surface by pits or depressions corresponding to subcutaneous contractions in the healing gummatous collections.

In turning now to strumous disease of the synovial membrane, we must leave the detailed discussion of the constitutional condition to the essay on Scrofula, vol. i. (see also Caries of the Spine), and direct our attention chiefly to the local changes.

This is essentially a disease of early life, met with mostly in those whose general vitality is low, and who are surrounded by defective hygienic conditions. Some pathologists see in the last factors adequate reason for the low inflammation and subsequent degenerative changes characteristic of the disease. They regard the inflammation as started by some external influence (such as slight injury or exposure) in tissues of less than ordinary vitality, easily yielding in the first place to the morbid stimulus, and in the next deficient in power to recover their lost balance after the latter is exhausted, and therefore slowly undergoing degenerative change. Others, again, admitting the deficient vital force inherited or due to mal-hygiene, believe that this is a factor in the disease only so far as it renders the tissues incapable of withstanding the attacks of minute organisms introduced into the blood through some of the superficial ulcerations of the skin or mucous surfaces so frequent in childhood (see Caries of Spine). These microbia, which, in a fairly healthy body, would be neutralised or annihilated by a superior force in the human cells, are able in the enfeebled body to multiply enormously, and eventually to gain the upper hand in situations especially where, perhaps owing to a slight injury, the local vitality is still further lowered, where they form colonies and work particular mischief.

Whatever be the value of these theories as to causation, the changes in the synovial tissues in struma are fairly plain. We find in the first place sluggish hyperæmia, accompanied by slight hypersecretion, then cell exudation and proliferation in the synovial and peri-synovial, or even capsular structures, until all are converted more or less into a material resembling granulation-tissue. This is the 'pulpy softening' of synovial membranes so often spoken of. This soft tissue may now undergo various changes. With a return to health, it may be absorbed or converted more or less into fibrous tissue, producing in the last case some thickening and induration of the synovial structures. With persistence of the evil, the exudation and softening may gradually extend to the ligaments and bones, or, the hypertrophied swollen synovial fringes spreading between the latter, may convey the irritant to the surfaces of the cartilage and lead to their destruction (see pp. 349–350). And beyond this the granulation-tissue may itself alter in structure. It may either degenerate rapidly, forming small cold abscesses full of curdy material, or it may caseate slowly in patches producing soft cheesy foci of greater or less size and consistency. These latter, and even the small

abscesses, may with returning health become absorbed before rupture, or converted into cretaceous nodules; but, as a rule, sooner or later they make their way further and burst, either through the skin or into the joint, though not so frequently in the latter direction as is supposed.

The objective symptoms of this disease of the synovial membrane, commonly called 'white swelling,' upon which we base our diagnosis, are slight heat with little or no redness, swelling of the joints (best seen where the capsular structures are thinnest), usually of an elastic consistence, or doughy if caseous degeneration be in process; slight effusion in some cases with fluctuation. Subjectively we find very little: slight throbbing and uneasiness may be complained of, but pain is not marked, unless the part be moved or unless the bone be also diseased, when it will be gnawing in character, especially at night. There is no starting of the limb in simple cases.

The general treatment of the two conditions, strumous and syphilitic disease of the synovial membranes, is entirely the same up to a certain point. Constitutionally, everything is aimed at which can possibly raise the vitality of the whole system; hence abundance of suitable food, good clothing and fresh air, dry and not too cold, are called for, with tonics, cod-liver oil, and alteratives, either mercurial or consisting of the iodine preparations. Locally, complete rest for the part, with active counter-irritation in the earlier stages of the strumous affection, not in the syphilitic. This should consist in repeated blistering, painting with iodine tincture, or, in chronic cases, the application of the actual cautery to the skin over the affected joint, either to produce mere vesication or an open sore.

But besides all this some special methods of treatment deserve a few words of notice. Thus the influence of mercurial inunction, combined with firm and even pressure, kept up upon the part by means of strapping, is regarded by some as particularly valuable where it can be applied. It is supposed that the absorbent action of the mercury is here aided by the even pressure. Others employ elastic bandaging,[1] alternating with shampooing, but without absorbent applications. It is supposed in this case, that the elastic bandage, applied each day for a certain time, will tend to unload the passively engorged vessels, while the stimulus of rubbing and chafing the part encourages a more active vascularity. This line of treatment deserves a fair trial. Again, on the theory that strumous inflammation is due to the presence of microbia in the blood, another method of treatment has been proposed and practised by Hueter—namely, the injection of small quantities of a two and a half to five per cent. solution of carbolic acid into the synovial tissues by means of a hypodermic syringe. This is supposed to remove the source of inflammatory irritation, by destroying the colonies of organisms presumed to be present. The proceeding itself is simple, consisting merely in so injecting the solution, ten to fifteen minims at a time around the joint, that the area of diffusion from each puncture shall overlap the last somewhat. This has to be repeated over and over again at intervals of a few days. Professor Hueter claims for this method a prominent place among the modes of treatment both of strumous disease of the synovial membrane and of bone. And it would be well, perhaps, if a fair trial were given to it on the recommendation of so good an authority; it is hard, at least, to see how it could do any harm to either the joint or the system.

The next group of joint affections which must engage us for a few moments is characterised primarily neither by effusion nor cell-proliferation (although these are present secondarily in many cases); we have here changes which resemble degeneration more than anything else. But, though the diseases belonging to it are here considered in connection with the synovial affections for convenience sake, it may at once be stated that the morbid changes of this group are not limited to the synovial membrane, but almost invariably involve each and all the structures of the articulation eventually. This is particularly true of *gout*, the first of the group. That the articular changes here are due to the presence of a definite chemical poison there can be no doubt. This is well known now to be urate of soda, whose existence

[1] Martin, *Trans. Internat. Med. Cong.* 1881, vol. ii. p. 444.

in the blood and tissues is due to those errors of digestion consequent usually upon the too abundant use of nitrogenous food and habits of life hostile to healthy combustion and elimination. This substance appears to deposit itself in the solid form by preference in the tissues of lowest vitality, *i.e.* in cartilage ligaments and capsular structures especially of the extremities, less so in the vascular synovial tissue proper and in the bones, rarely in the highly organised parenchymatous structures. The question then suggests itself whether this deposition may not be due, at all events in part, to the lack of vitality in the tissues mentioned, owing to which they are unable to eliminate or resist the power of the salt to crystallise, which it does therefore in tufts of acicular prisms. In solution, too, it passes into the joint with the synovium, and is there precipitated in crystalline form, and often in sufficient amount to distend the synovial sac with a mass resembling chalk. It is the presence of this product which is supposed to provoke that hyperæmia which culminates in the explosive attacks of inflammation of the peri-articular structures so familiar to physicians. It is probable, also, that its existence in solution produces a lowering of vitality in the tissues in which it is found, laying them open to the degenerative changes which are found. The characteristics, then, are the gradual deposit of urate of soda in the articular structures, commencing in those of least vitality and slowly involving the others. The hyperæmias and subsequent degenerative changes are but consequences of this deposition. For any further description of the disease and its treatment the reader is referred to medical works. It is described here thus far for completeness sake, but is commonly regarded rather as a medical than as a surgical ailment.

The remaining disease of this group has apparently much in common with gout in its general characters, but still differs from it in so many important particulars as to deserve a special name. What this should be is a difficulty : it has been known variously as *arthritis deformans, rheumatic gout, chronic rheumatic arthritis, chronic osteo-arthritis, arthritis senilis, arthritis sicca,* or *nodosa,* and lately has been dubbed *polypanarthritis* ! To most of these names there are objections which need not be considered here ; to the first perhaps least, as it describes the affection generally without implying any theory as to its causation, about which there is still ample room for discussion.

Arthritis deformans is essentially a disease of advanced life, occurring in a vast majority of cases after the age of fifty. In some few instances it will be met with earlier in feeble patients. Among the ill-fed and clothed it is far more common than among the upper classes, differing thus from gout, with which it has otherwise much in common. Indeed it is sometimes familiarly known as ' poor man's gout.' Habitual exposure to vicissitudes of weather appears to dispose to it, but whether by acting locally upon the joints or, as seems more probable, by affecting the general nutrition of the body, is not determined. The disease, then, to many pathologists appears on these general grounds at all events to commence in some loss of vitality in the tissues, owing to one or more of the above influences, which leads to degenerative changes. As the condition advances, however, the introduction of other secondary factors is recognised in the shape of low inflammatory processes due to the disturbance of function in the first instance by the degenerative changes. It would be incorrect, then, to describe it in the form commonly met with as purely degenerative, seeing that its most to be deplored results are those produced by secondary inflammation, and this not even always destructive, but often of a plastic character.

If we look into a joint in which this affection is in its earliest stages, many striking changes may be observed even with the naked eye. In the first place, the encrusting cartilage may appear roughened, and on close examination fibrillated, but without any evidence of inflammation. This alteration is supposed to be the result of degeneration of the cartilage cells and their removal, leaving behind the intercellular matrix in the form of columns or fibres. It may be due to age, exposure, unhealthy poison-containing blood reducing the vitality of all the tissues, or, to all these causes combined. This is probably the first change of all in this disease, and

before it has progressed very far leads to actual loss of substance in the cartilage. For, the latter in its degenerated condition appears unable to fulfil its functions, and is gradually worn away in the movements of the limb, until eventually bone surface meets bone surface. Another condition may be noticed at the borders of the encrusting cartilage, advancing *pari passu* with the change just described. This is an irregular swelling of the tissue producing small eminences of a pearly hyaline look or yellowish colour. They are noticed at those parts of the surface least used in the ordinary movements of the joint—namely, at the borders of the encrusting tissue, where it is close to the periosteal and synovial vascular supply, and only interfere with the smoothness of play of the latter during its extraordinary movements. These little eminences are undoubtedly due to hyperplasia of the cartilage. And this hyperplasia is explained either by the irritation produced by the play of those parts of the joint surfaces which are undergoing degeneration against one another in

Chronic Osteo-arthritis of the Knee-joint. (From a preparation in the Museum of the Middlesex Hospital.)

FIG. 65.—Anterior view.

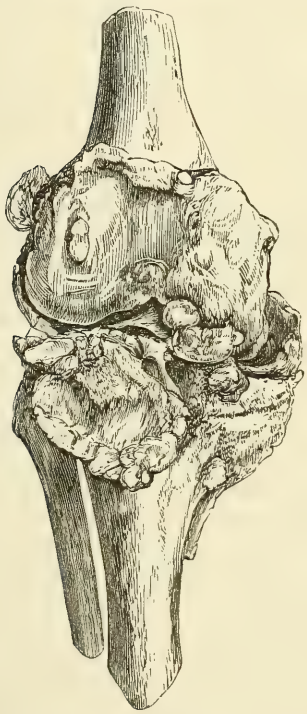
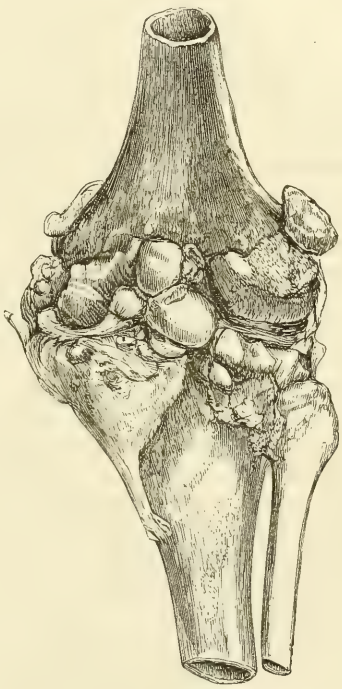


FIG. 66.—Posterior view.



their roughened state, or by the presence in the blood of some irritating matter. But the first of these seems the more likely hypothesis. Slight congestion is also observed in the nearest vascular tissue, *i.e.* the synovial membrane, but not sufficient in most cases to do more than produce trifling hypersecretion. This irritation of the synovial membrane was supposed by Cruveilhier, Adams, and Sir B. Brodie to be the initial change; but, as stated, there appears to be an earlier degenerative one in the cartilage. As the disease advances, however, and the cartilage becomes more and more worn away until bone actually plays against bone, the irritation becomes greater. The cartilage at the borders becomes more lumpy, the irritated bone commences to throw out osseous tissue at the periphery of the joint, while worn and eroded by friction at the points of contact. All this is a slow process, and the new osteophytes are made up of a soft spongy tissue, likened by Billroth to 'tallow drippings,' which during the movements of the joint is moulded more or less so as to accommodate the latter. The synovial membrane too becomes thickened and roughened,

and covered in many cases with hyperplastic fringes or pendulous growths. These latter occasionally become detached in the movements of the joint, and form loose bodies.[1] Or they may become ossified, and then detached, forming what are known as 'aditamentary bones.' Figs. 65 and 66 [2] illustrate the condition of a joint in this stage. We see the worn surface of the femur where it played against the tibia, the large masses of new bone-tissue which has been formed around the ends of both bones, forming at one or two spots 'aditamentary' bodies. It is the presence of this new osseous material which gives the nodular appearance and feel to the part as seen and felt through the skin, and which sometimes so completely surrounds the joint ends as practically to prevent all movement. Here there is no true synostosis, or fusing of the bones together; they are simply locked one into the other. But the above is not always the exact course of things. In some individuals the degenerative process appears to progress very slowly, the tissues having for some cause more vitality. Here the cartilage only disintegrates very tardily, and the underlying bone is thus brought under the influence of direct pressure by easy gradations. The consequence is an osteitis differing from the plastic described only in being less active; by this process deposit takes place in the porous ends of the bones themselves, thus rendering them very dense. This sclerosis now further prevents any rapid destruction, one hard surface meeting another equally so. And in playing one upon another the surfaces become worn extremely smooth, and, being hard, eventually take a polish as bright as that of porcelain or ivory, which is not seen so long as they are soft. In this state the movements of the joint may be tolerably even, although dry creaking will be felt by the hand placed externally.

Occasionally, but very rarely, the degenerative changes go so far as to produce a kind of caseous suppuration in the joint. In this case we shall find patches of injection within the latter, with here and there breaking down of the bone and last traces of the synovial tissues into curdy material, which is found floating in the turbid fluid now more or less filling the joint. Such a state of things may last for months or years, the exterior of the joint being more or less discoloured in patches, swollen and doughy, but hardly presenting any signs of inflammation.[3] The fluid may then be slowly absorbed, and the softened surfaces of the bones mould themselves as above described, until they eventually lock. On the other hand, the fluid, with its curdy admixture, may slowly work its way to the surface with but slight inflammatory disturbance, and at last perforate the skin, discharging for a longer or shorter period. In this state the cavity is apt to be infected with some septic matter sooner or later, completely altering the complexion of the case. The process now becomes actively inflammatory, with free suppuration, and may soon destroy the articulation or the patient's life if the diseased parts be not removed by a timely operation.

All these various phases of *arthritis deformans* are accompanied by symptoms subjective and objective. In the earliest stages, when the cartilage is degenerating, the patient will first notice some uneasiness and creaking in the joints, with slight weakness and insecurity in putting it to its work. Nothing objective can now be made out except that the roughened surfaces actually do creak under the hand on movement. A little later, when the low inflammatory action is beginning, and the border of the cartilage is in a state of hyperplasia and is becoming nodular, while the synovial tissue is irritated, pain is complained of both constant and on motion. The latter, too, is also accompanied by much greater creaking or crackling. Objectively there is also lumpy enlargement of the borders of the joint, which may now contain more fluid than usual; there may be very slight heat about it too, but no redness. Its

[1] Barker, *Trans. Path. Soc.* vol. xxx. p. 363.

[2] De Morgan, *Trans. Path. Soc.* vol. xix. p. 319.

[3] Some years ago I had an opportunity of dissecting a joint in this condition after death, in which there was besides the distinctive change on its surfaces, a well-defined abscess in the head of the tibia, which had opened into the articulation, just as one sees in the strumous disease. The other joints of the body showed advanced arthritis deformans. This condition suggested very forcibly the possibility of hybrid disease, to which attention has recently been called by Professor Verneuil at the International Medical Congress. See *Trans.* vol. ii. p. 373.

movements again are more or less interfered with, not only owing to pain, but also to the presence around the free margins of the articular surfaces of the eminences and nodules alluded to. Any attempt then to flex to the full extent of a normal joint puts the lateral and other ligaments on the stretch, thus causing increased suffering. With each further stage of the disease these symptoms become more marked, especially the last—namely, limitation of movement. Eventually, if the joint become quite locked, no pain will be felt. If breaking down of the structures of the joint occurs, the objective symptoms will be, some œdema, redness, swelling and fluctuation, but never to the degree met with in ordinary inflammation; the pain, too, is not so severe, nor the heat and throbbing, the whole process being very indolent.

Few joints in the body, if any, have immunity from this disease, but some appear to be more frequently affected than others. Among the larger articulations, the following is about the order of frequency: hip, knee, shoulder, elbow, ankle, sterno-clavicular and temporo-maxillary, the smaller joints showing it only a little less frequently; even the vertebral joints may be extensively involved in the disease.

Both sexes appear equally liable to arthritis deformans, but it has been noted by Haygarth and Adams that the larger joints are more frequently attacked in males, the smaller in females.

When we turn to the question of the treatment of this affection, we are not encouraged by any results that have hitherto been obtained. Cure of the condition when marked there is none known; the structural changes cannot be repaired. The most that can be said upon the subject is that we can probably help to arrest the disease before it has become very advanced, or in the latter case to relieve to some extent the suffering produced by it. Regarding the whole condition as commencing in degenerative changes, we can improve the vitality of all the tissues by ordering good, nourishing, but light digestible food, careful clothing, fresh air and tonics, or, if the vitality of the tissues be lowered by the excesses of eating or drinking surcharging the blood with deleterious matters, we can, by regulating and simplifying the diet, encouraging the action of the skin by Turkish baths, and other eliminating organs, advance in the same direction. Locally the nutrition of the part may be helped by protecting it from exposure to the vicissitudes of climate by means of coverings of cotton-wool or flannel; also by systematic rubbings, with or without stimulating liniments, all round the part affected. Douches and hot baths for the latter are also sometimes of use, and even counter-irritation may be resorted to occasionally. Pain may be relieved by the local application of anodynes in the form of liniments, belladonna or opium being preferred. Small doses of iodide of potassium, too, with carbonate of lithia, I have often noticed have more or less power of relieving the pain of this disease, though how is hard to say. Numbers of other drugs have also been given, but their very number and variety show that no one among them has proved constantly useful.

Of the benefits, on the other hand, accruing from residence at some of the bath resorts, I think there can be little doubt. Wherein the particular virtues of these places lie, whether in the particular quality of the water drunk, or in the action of the baths upon the local or general condition, or in the regular habits of life and careful dietary, it is impossible to say in every case. But of this I am satisfied, that patients whom I have known have been much benefited by a sojourn at Wildbad, for instance, when other treatment appeared to lead to no good results. The other resorts generally regarded as beneficial in this disease are Buxton, in England, Luchon, in the Pyrenees, Vichy, Ems, Wiesbaden and Carlsbad. But of all I would give the preference to Wildbad, which, for some reason or other, appears peculiarly suited as a resort for those affected with arthritis deformans, rheumatism and gout.

Affections of the Ligaments.

The affections of the *ligamentous structures* of joints have next to be considered, and can be disposed of briefly. For here it is nearly always a question of extension of disease, either from the bone or synovial membrane. Primary disease of ligaments

is extremely rare for reasons already given (p. 333). Occasionally, however, after some severe strain or stretching, they become the seat of inflammation. This is usually sluggish, the tissue affected being normally far from vascular and consisting of very highly developed connective-tissue with few embryonic elements in it. After such an injury, too, the other structures of the joint are often also involved in the inflammation, and this may mask the condition of the ligaments. The latter, if inflamed, will be found somewhat injected with vessels passing among their tough fibres, and if this hyperæmia be not soon reduced, also softened and thickened by plastic exudation. The diagnosis of such an injury, in the first place, would not be difficult in view of the history, probable ecchymosis, localised pain and tenderness increased by particular movements. The subsequent inflammation would be indicated by heat, throbbing, swelling, and increase of pain, in addition to the first evidence of injury. There might also be some effusion into the joint if the synovial membrane had become irritated. The treatment of ordinary cases of inflammation after strain of ligaments is plain : complete rest for the part, with local depletion by leeches or wet cupping ; ice in the early stages, hot belladonna fomentations in the later. When all evidence of inflammation had subsided, the part would require (if the joint be suited to it) firm strapping with adhesive plaster to support the weakened ligaments and prevent passive congestion. Indeed, if bad strains or 'sprains' be seen early enough before inflammatory reaction has commenced, they may be most advantageously treated in most joints by well-applied strapping from the very first, combined with complete rest.

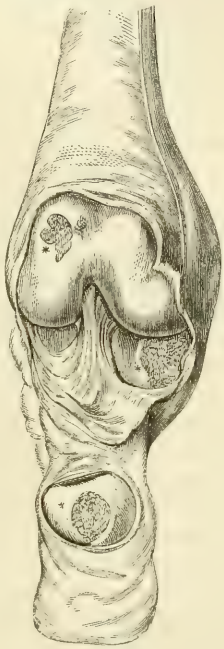
In weakly individuals of low vitality this hyperæmia of the ligamentous structures after injury is very prone to become chronic and to lead to much softening and swelling. Again the ligaments may become gradually involved in disease which has had its starting-point either in the synovial tissues or the bone. Here the changes will be the same as in the much rarer primary disease, and will be usually much more extensive than in the latter (see p. 342).

Affections of the Cartilages.

When we come to consider the *primary* changes in cartilage, we find that, as in the case of other non-vascular tissues, whose functions are of a passive order (*e.g.* cornea, arterial coats) they are almost solely degenerative. When the cartilage shows any active change, it is almost invariably secondary to an active process approaching it from one of its surfaces, not starting in itself. But the degenerative alterations of its structure are primary. They depend upon a loss of vitality in its cells, by virtue of which fatty change takes place in the latter. In cartilage, thus affected, small oil globules are to be seen packed around the nucleus of the cartilage corpuscles and replacing their protoplasm. The matrix thus losing its centres of vitality, degenerates and cracks upon its surface, the inumerable fissures deepening as the process advances, until the appearance of the encrusting material is that of some 'pile' fabric, such as velvet, or, when the finger is passed over it, may look like a field of corn beaten down by the wind. Sometimes there is also seen a deposit of small fatty granules in the matrix itself, lying in rows vertical to the surface, and along these lines the splitting of the tissue takes place. Such changes are constantly met with during post-mortem examinations where no evidence of joint disease had been observed during life. It appears probable that they may be due to age in some cases, though in many aged people they are absent. It is better, however, to regard them generally as depending upon the same conditions which lead to fatty degeneration elsewhere—namely, loss of vitality. We can then view the latter as depending upon age, lack of sufficient food, or the circulation in the blood of deleterious matters interfering with the nutrition of the tissues. That the latter cause may operate is shown by the analogous condition of cartilage produced in gout. Here, as the result of either errors of assimilation or elimination or both, a harmful matter accumulates in the blood, and is carried by it through all the tissues of the body, inducing changes already alluded to (p. 344). When very abundant in the blood this urate of soda is

deposited in the cartilage, and may give the latter almost a chalky appearance. Its presence here leads to lowering of the vitality of the tissue, which consequently undergoes degenerative changes, its matrix breaking up as in the above fatty change, and finally being completely absorbed. But it is probable that similar hurtful matters may produce the like lowering of vitality in tissues, while in solution in the blood and plasma, as we see these do when actually precipitated in the solid form. This, if true, would probably account for the changes in the encrusting cartilages which we suppose to be the starting-point of arthritis deformans (p. 344), which have a certain resemblance to those of gout, though the actual hurtful material is unknown. These degenerative changes, then, whatever their cause, are almost the only known primary diseases of the cartilages of joints. That pearly swelling of the borders of the latter alluded to as present in the early stages of arthritis deformans is probably only a secondary hyperplasia, due to the irritation produced by the bone surfaces coming into contact as the cartilage over the ends degenerates. As to new growths springing from articular cartilage, they are almost unknown.

Fig. 67.—Incipient Ulceration of Cartilage. (Museum of St. George's Hospital.)

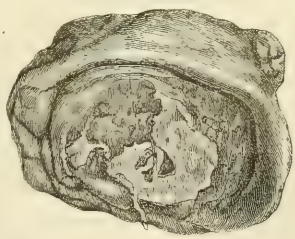


Secondarily, however, joint cartilage is affected by inflammation as any other connective-tissue. That is to say, if any strong irritant be brought into contact with either of its surfaces, its cells go through the same proliferative changes as those of the group of tissues to which it belongs, and the intercellular material is similarly altered thereby.

The usual causes of inflammatory destruction of cartilage are either strumous or one or other form of septic synovitis, whether produced by direct infection of the joint, or systemic intoxication, or strumous disease of the underlying bone. The destructive process varies only in degree with each of these causes, and need only so far be described for each.

When such a state of simple acute synovitis exists as that sketched at (pp. 335 and 336) the products of inflammation are brought into contact with the surfaces of the cartilage, either by the overlapping of the congested fringes of the synovial membrane or by the pus effused. These act as irritants upon the cartilage, whose corpuscles consequently commence to proliferate until those 'mother capsules' nearest the surface are distended with small round indifferent cells. This distension goes on to rupture of the capsules towards the joint, thus producing little pits upon its surfaces. Through these depressions the irritants now reach deeper still, causing the same proliferative changes in the next series of cells, which likewise burst into the joint. In this way the encrusting covering may be honeycombed even as far as the underlying bone. Between these hollows or ulcers (fig. 67), if we choose to call them so, there remains for a time a certain amount of the original intercellular matrix of the cartilage in the form of columns or filaments. But not for long; for their nutrition is so much interfered with by the changes in the capsules, that they rapidly break down and dissolve, and thus all the elements of the cartilage are destroyed (fig. 68). Sometimes, however, as in strumous synovitis, where inflammation is sluggish, the cartilage is only pitted here and there over its surface by these small ulcers, leaving healthy tissue between, or is eroded simply at its margins in a line corresponding to the inflamed synovial membrane overlapping it.

Fig. 68.—Ulceration of Cartilage. (From a preparation in the Museum of St. George's Hospital.)



Where the stimulus or irritant is very potent in the joint, on the other hand, *e.g.* where septic pus is present, the process is essentially the same as in simple suppurative synovitis, except that the intensity of the process of destruction is so great that the matrix is dissolved *pari passu* with the proliferation of the cells within the capsules and the bursting of the latter, and as a consequence we do not usually find pits or ulcers on the cartilage, but a general removal of all its constituents simultaneously. Under these conditions the cartilage presents the appearance as though its surface had been digested or dissolved away by some corrosive fluid poured upon it. It is thinned either uniformly or over tracts, but smoothly, and without any notable change of colour, so that it may look at first sight as hardly altered at all, with the exception of being extremely thin. A section of what remains, however, will show the proliferation of its cells taking place rapidly.

But cartilage may be equally destroyed by inflammatory stimulus reaching it from below through the underlying bone. The process here is almost identical with what we have just seen. It may be rapid, or slow, which is more common. In a case, for instance, of rarefying non-suppurative osteitis in the end of a bone, where the inflamed medulla is expanding at the expense of the true osseous substance in all directions, it comes eventually to press against the under surface of the encrusting cartilage. The cells of the latter now commence to proliferate, as already described, and the capsules to burst—this time, however, towards the centre of inflammation, *i.e.* the bone. The inflamed medulla now enters the pits thus formed, and so carries the stimulus to the next series of cartilage cells, which go through the same process, again admitting the medulla a step further. Finally it will be found that the latter has pushed its way quite through the encrusting cartilage into the joint, and now forms islands of granulation on the surfaces of the latter tissue, in the middle of otherwise healthy cartilage. Vertical sections will show these islands to be nothing more than the apices of bosses of the inflamed medulla of the bone beneath, which have tunnelled up from below. When the granulation-tissue advances upwards more evenly and more rapidly, especially if it be accompanied by the formation of pus, the above process is so far modified that portions of the encrusting cartilage are lifted off as it were, and thrust into the joint in the form of flakes or worm-eaten plates. This exfoliation is not, on the whole, infrequent, the flakes looking comparatively normal, except on their under surface. All these varieties of destruction of cartilage may be met with in the same joint, one at one part of the surface, the other at another.

The *symptoms* of destruction of cartilage, apart from those of the joint diseases which usually lead to it, are few. Objectively we have in the degenerative form an unevenness of play of the surfaces one upon the other, or creaking at the same time. In the inflammatory forms as described, the painful condition of the whole joint will prevent any movement, unless the patient be anæsthetised, in which case the roughened condition of the surfaces may be made out by gentle flexion and extension, and perhaps by a little lateral movement. It is generally held, too, that when in the course of inflammation of joints the limb commences to start painfully and involuntarily, especially at night, ulceration of cartilage is present. The suffering produced by these startings is often great, and particularly as the patient is unable to control them. They do not commence until the destruction has gone so far as to bring the two bony surfaces nearly or quite into actual contact. The explanation of the phenomenon is probably this. Cartilage itself is not a sensitive tissue, though the underlying bone is so. When the former is ulcerated over two bones at their points of contact, the muscles ruling the joint will involuntarily do all in their power to prevent the inflamed bone surfaces from rubbing one on the other by fixing them in one position, simple contact of the diseased spots apparently producing no pain. When, however, the muscles become fatigued from time to time, or the patient is dropping off to sleep, the former relax a little, the diseased surfaces consequently move one upon the other, causing acute pain at the moment, and sudden reflex contraction again with aggravation of the suffering. This symptom does not accompany every kind of ulceration of cartilage. In the pyæmic affection of joints, for instance, where the encrusting cartilage is being uniformly and rapidly

removed, it is often absent. Nor is it a positive sign when present, its value depending much upon its association with other evidences of disease.

The treatment of ulceration of cartilage has nothing special about it, apart from that which would be suitable in an ordinary case of destructive synovitis of one kind or other.

Affections of the Bones.

Turning now to those diseases of joints which commence in their bony constituents, and which are mostly of the inflammatory type, we find them less commonly the distinct result of simple local causes than the consequence of constitutional conditions such as scrofula, or those leading to *arthritis deformans*. Even when they have apparently started from injury, exposure, or other strictly local influence, it will usually be found that some constitutional taint has prepared the way for the changes that occur, or, in other words, rendered them particularly susceptible to inflammation. For a detailed description of the morbid changes in osseous structures the reader is referred to the essay on Diseases of the Bones. We are only concerned with them here so far as they can be said to affect the functions of the joints. This they may do in several ways. On the one hand, they may extend directly into the latter, with or without suppuration, or, on the other, they may induce by their proximity a congestion of the remaining articular structures, with slow alteration of their structure. The first sequence is not often met with in simple osteitis of the articular ends of bones, such as follows injury or exposure. It is the more chronic affections depending upon constitutional states that are most to be feared in relation to the functions of the joints. Of the general states which have an effect upon the latter, it has been shown that gout and arthritis deformans probably only here affect the bones secondarily, and the same may be said of the more acute septic conditions of the system. In struma and syphilis the case is different, however. Here the course of the disease is not infrequently from the bone primarily to the other structures of the joint. Without going into details here, it may be briefly stated that the process is usually with each of these causes either sub-acute or chronic. Indeed it may be taken as a general rule that none of the acute affections of bone extend into the joint; they stop short at the epiphyses. Again, in both struma and syphilis the form which the bone affection takes is much the same in both cases. In each we find a hyperplasia of the medulla in the end of the bone leading to the formation of an abundant granulation-tissue. This may then either gradually expand into the joint, through the encrusting cartilage as described already (p. 350), or may undergo degeneration, and form osseous abscesses which make their way in the same direction; but this last is rare, for such fluid collections tend rather to present externally before implicating the articulation. When we come to examine into the question as to where this process begins, we find ourselves on interesting ground. We find, in fact, that (in struma at least) we are dealing with an inflammation at the epiphysary line of the bone in many, if not by far the greatest number of cases; we have, in fact, primarily an *epiphysitis* before us. This may or may not implicate the joint surfaces secondarily, and this depends greatly upon the structure of the articulation next the inflamed epiphysis. But the disease is so frequently mistaken for and treated as a true joint affection, and otherwise misunderstood, that a few words of special description of it may not be out of place here.

Premising that this is always a disease of early life, and remembering the amount of young vascular tissue undergoing developmental changes in the epiphyses and the activity of the processes involved, we are not surprised to find the physiological activity very often driven on into morbid excitement by a variety of causes. Thus, slight violence which would have no effect whatever upon the fully developed parts of a bone, may be quite sufficient to excite morbid hyperæmia in the delicate, almost embryonic tissue of the growing epiphyses. And the same may be said of exposure to extremes of heat and cold, &c. Again, those general morbid influences which operate from within find here conditions very favourable for their local development. Thus in certain septic states, just as we meet with inflammation in the growing

medulla of young bones, the well-known acute osteomyelitis, or in the deep vascular layer of the young periosteum leading to acute suppurative periostitis, so, in the analogue to the last tissue—namely, the growing line of the epiphysis—do we meet with inflammation, either alone or associated with one or both of the affections just named. The embryonic elements, here naturally proliferating as they are, require but little excess of stimulus to produce pus, and this stimulus is supplied over and above by the *materies morbi* of the septic state, whatever this be. The same may be said of struma, if it be true, as appears probable, that it is due to the presence of organisms in the blood (see p. 333). These passing through or actually lodging in the fine vessels of this line provoke a similar, less intense, but more permanent irritation. The syphilitic virus probably acts here in the same way and for the same reasons.

We have now before us in these some of the best known causes of acute epiphysitis and in struma and syphilis of the more sub-acute or chronic forms. But, in studying the condition more generally, it is almost impossible to avoid the conclusion that in that class of affections alluded to as sub-acute septic conditions (p. 337), epiphysitis will not unfrequently be found when more carefully looked for, just as the synovial affections are frequent here. It also appears not at all impossible that such sub-acute septic conditions may be inherited from the mother. Take dysentery, for example, which we know is often followed by joint affections in the adult, and note a remarkable case, recorded by Mr. Macnamara,[1] where disease during pregnancy after this disease in an otherwise healthy mother was followed by the birth of a very weakly child, who shortly after was found to be affected with extensive epiphysitis in several bones (syphilis or other disease was absolutely excluded in this case). This suggests, at all events, the thought whether septic conditions of the blood, often found with dysentery, may not be transmitted to the fœtus in utero, and only produce actual structural changes after the infant has been embarked upon its own independent existence, and no longer supported by the vitality of the mother. If this be true, and there appears no reason why it should not be as reasonable as the hereditary transmission of struma and syphilis, it opens up a wide field for speculation as to the possibility of the inheritance of a variety of septic states from the mother, developing rapid disease within a short period after birth, not only in the bones, but elsewhere. It is possible that such a construction may be put upon the occurrence of the disease, in some of the cases in that extremely interesting series published by Mr. T. Smith,[2] of what he called 'Acute Arthritis of Infants.' Here the starting-point of the morbid process was shown in almost every case to be the growing line of the bones of the joint. In some the disease was plainly pyæmic, while in others, for want of post-mortem examination of the viscera, we are left in doubt upon this point. Such pyæmic states no doubt frequently have their origin in the new bore, in putrid changes at the point of ligature of the umbilical cord; instances of this most pathologists are familiar with. But there are others in which septicæmia or pyæmia occurs with infants soon after birth in every degree of severity, and where post-mortem no trace of any source of infection about the cord or hepatic vessels can be discovered, or indeed in any part of the body. In such cases the possibility of inoculation before birth occurs to the mind. If, to take the same example again, dysenteric inflammation of the bowels, met with in the tropics, be due to the effort of the part to eliminate a poison circulating in the system, and if, as we know, joint affections frequently accompany this disease, and if it be shown by further observation that, as in Mr. Macnamara's case, a child born of a patient suffering from dysentery may exhibit evidences of blood-poisoning, it is not illogical to suppose that it may have contracted the septic conditions in utero just as it might contract syphilis or small-pox, as is believed possible by many.[3] It will perhaps behove us then, in the future, in inquiring into the family history of such little patients as are brought to us with diseases about the lower ends of joints in very early life, to inquire just as carefully about any

[1] *Diseases of Bones and Joints*, 2nd ed. p. 85.
[2] *Bartholomew Hospital Reports*, 1874, p. 189.
[3] Hutchinson's Lectures at the Royal College of Surgeons, 1881.

morbid states of the mother during gestation which could be traceable to sepsis, as we always do now about the possibility of syphilis or scrofula.

It is impossible to avoid these considerations, however hypothetical, in studying this question with the help of many published cases, and one's own observation, clinical and pathological, and in the light which is being daily thrown more and more clearly upon the possibilities of heredity. But, without carrying them further, we may now glance at the disease as we meet with it clinically.

Epiphysitis is met with in the acute, sub-acute, and chronic forms. Generally speaking, it is not found in healthy children whose vitality and family history are good; but in some cases where it exists the child's state in both respects has been irreproachable, for all we can find out. It must be admitted, therefore (at all events for the present), that it may be caused in some cases by external influences alone, such as blows, strains, exposure, &c. But it must equally be admitted that it can arise spontaneously quite independently of these, owing to causes operating from within in the form of constitutional disorders, such as syphilis, struma, and septicæmia. Some of these latter are beyond all doubt hereditary, such as syphilis and struma, others probably so in certain instances, such as some of the sub-acute septic conditions, if not the acute.

Acute epiphysitis is very frequent in early infancy. In 22 cases recorded by Mr. T. Smith, 8 occurred in the first month, 19 within the first six months, and 3 within the first year. Although frequently accounted for by a blow, squeeze, or strain, such as might occur during a difficult or instrumental delivery, very often there is no history of injury; and, in considering the cases carefully, we are tempted to suspect that in the majority of these acute affections we are dealing with a form of pyæmia or septicæmia independent of injury.

The disease is characterised by the rapid development of inflammation in the growing lines at the end of the diaphyses, sometimes within a few days of birth. This tends to run on rapidly to suppuration, the pus making its way either directly through the articular cartilage into the joint, or more frequently spreading over the whole growing plane, and separating the epiphysis from the diaphysis completely, finally bursting through the periosteum over the junction of shaft with epiphyses. Finally it may run up into the shaft more or less. When it passes off laterally alone and through the periosteum, it depends of course upon the anatomical relation of the epiphysary line to the capsule whether the pus shall make its way into the latter or not. In the hip, for instance, the joint is inevitably involved, while the knee may escape, the pus travelling outside of the capsule. When the joint is invaded by the pus, the result is usually a rapid solution of its cartilages, and in some cases of its bony constituents, to a greater or less extent. But in other cases the distended capsule bursts early, an abscess is formed in the soft parts, and opens externally, and after discharging for a time heals, and from the movements of the joint we are forced to the conclusion that its surfaces have not been damaged seriously. In those cases where in the first instance the pus travels into the soft parts quite clear of the joint, the latter may escape completely, but often it is secondarily involved at a later date. The rapidity with which abscesses form in connection with this disease is very remarkable. But the possibilities of repair after they have been drained are even more so. Occasionally when the disease has run its course, and the abscess has been opened, or burst externally and discharged, perhaps for weeks, the patient recovers, and has a very useful though shortened limb, with no trace of anchylosis, fair strength, and all its movements complete, or perhaps an increased mobility.

Just as in the syphilitic form of the affection we shall see presently the acute disease is most frequently found in those bones which add to their length most rapidly, and at the ends which contribute most to this, or, in other words, at those spots where physiological activity is usually greatest in bone. Thus among Mr. Smith's cases I find that, of those which proved fatal, out of 22 joints affected in thirteen infants, the hip was the seat of disease ten times, the knee five times, the shoulder four, the elbow, ankle, and sacro-iliac joints each once. Of those nine cases which lived, out of twelve joints affected there were five knees, three hips, two

elbows, one shoulder, and one ankle. This is only a rough estimate made from a limited number of cases, but is probably not far from correct.

Sub-acute and *chronic epiphysitis* is usually of strumous origin.

The first change noticed is usually a hyperæmia either of the nucleus of bone in the epiphysis or at the vascular line of union between the latter and the shaft. This is followed by proliferation of the medulla, which in the more acute cases forms pus, but in the usual chronic forms a quantity of granulation-tissue.[1]

These inflammatory products now spread out in one or other of three directions, sometimes in all (unless, of course, recovery takes place). They may make their way outwards until they reach the periosteum, pushing it away from the end of the bone, and finally piercing it, to appear in the soft parts, if there be such. Or they may advance upwards, through the cartilage, in the way already described. Finally, they may extend into the shaft of the bone to a greater or less distance. The easiest direction, however, for the inflammation to travel is laterally, along the plane of young tissue in which it originally commenced, and this it does generally. The joint proper is thus saved in many cases. But in other instances it is otherwise, *e.g.* the hip, where the epiphysary line lies inside the capsule. Here the inflammation of necessity reaches the joint surfaces in travelling along the plane of the epiphysis, and leads to more general disease. When the morbid process is extending in either the joint or shaft, on the other hand, it is usually a slower process.

In the last form of the disease (the *syphilitic*) to which it is necessary to make a brief allusion, we have somewhat an analogous process, usually sub-acute, to that taking place in struma. The disease has been studied by several observers in recent years, Wegner [2] being one of the first. His observations in some twelve cases have since been confirmed and amplified by Taylor,[3] Parrot,[4] Ranvier,[5] and others abroad, while at home cases have been recorded by Haward [6] and Goodhart.[7] This disease may be the result of either hereditary syphilis, or that acquired within the first few years of childhood. It consists in an inflammation of the epiphysal lines, chiefly of the long bones, producing in many cases complete separation of the end from the shaft, as proved both during life and after death. This may be accompanied by the formation of abscess, with sinuses externally, or may run its whole course even to great swelling of the ends of the bones and separation with abscess, and yet be recovered from in a short time. The inflammation is regarded by Wegner as secondary to the calcification to a large extent of the epiphysary cartilage, due to the irritation of the syphilitic poison; such calcification going on faster than the usual vascularisation, the earthy matter eventually acting as a foreign body and so leading to inflammation.

Ranvier, on the other hand, and probably more correctly, regards the inflammation as primary in the growing line, and produced directly by the irritant of the syphilitic poison upon the growing vascular tissue.

One of the most remarkable points about this disease, like the acute form, is the power of complete repair of the parts affected, even after entire separation of the end of the bones. This is clearly shown to be possible by several of the recorded cases. But it is not the rule, little patients affected in this way usually dying before long of the syphilitic cachexia. The affection may then be taken as indicative of very extreme syphilitic intoxication.

Epiphysal disease of all kinds just as it lies in the most active tissue of the bones may be expected to be most frequent in those bones which add most rapidly to their length. And this is so. It is most frequent in the lower end of the femur, then in the lower end of the tibia and fibula and upper of femur; then in the lower extremity of radius and ulna, &c.

With these few general remarks upon epiphysitis, necessarily very brief, we leave the questions of symptoms, diagnosis and treatment of the affection for consideration in the section devoted to the special joints, where it will be considered in relation to the latter.

[1] Some interesting observations on this subject are made by Mr. Barwell, in his work on *Diseases of the Joints*, 2nd ed. p. 333.

[2] *Virchow's Archiv*, vol. l. 1870, p. 305. [3] *Bone Syphilis in Children*, New York, 1875.

[4] *Archiv. de Physiol. Normal et Pathol.* 4me année. Paris, 1872, p. 319.

[5] *Mm. Hist. Path.* 2nd ed. p. 444. [6] *Trans. Path. Soc.* vol. xxviii. p. 356. [7] *Ibid.* p. 359.

Loose Cartilages.

This is perhaps the most convenient place to consider briefly the general pathology of those *loose bodies* sometimes found in joints, usually called '*loose cartilages*,' or '*movable bodies*,' and by the Germans *Gelenkmäuse*.

The existence of these has been known as early as in Paré's time, who, in opening a dropsy of the knee, in 1553, found and removed a hard, loose, stony body, the patient recovering. The first to remove one designedly, however, appears to have been Pechlin (1601),[1] a Swede, who operated for this condition expressly on a young man of twenty.

These bodies are most frequently found in the knee, and after this in the elbow, less frequently in the hip, though I have met with them here post-mortem myself;[2] they are rare, though not unknown, in other joints. They may be single or present in large numbers, Morgagni having found twenty-five in a joint, but as many as 200 have also been met with (Volkmann, *loc. cit.*) Pirrie mentions a case in which thirty-eight had been removed from the knee.[3] They have been found to consist of the following substances, taken in the order of greatest frequency—fibrous tissue, fibro-cartilage, cartilage either pure or partly calcified or actually ossified, bone only, fatty tissue, fibrinous material, and fibro-cartilage surrounding a foreign body, *i.e.* the point of a needle. In size they vary from that of a pea to that of a small chestnut, and their shape is as variable, tending usually, however, towards the flattened oval. Their mode of production has been variously explained from time to time, but the theories now held with regard to this point may be classed briefly in two categories. They are supposed to be produced either by inflammation or by injury. Each of these causes, again, is supposed to act in two ways.

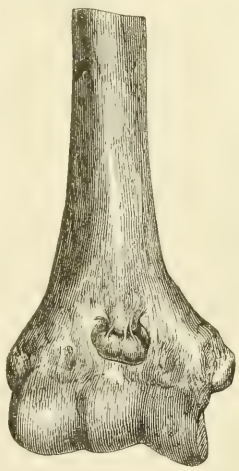


Fig. 69.—Cartilaginous Growth connected by a narrow pedicle with the coronoid fossa of the humerus. (From a preparation in the Museum of St. George's Hospital. Series iii. No. 145.)

(*a*) Inflammation either throws out a quantity of fibrinous material into the joint, which becomes consolidated, and, in the movements of the latter, moulded into pellets and nodules (Hunter), or (*b*) by exciting hyperplasia in the synovial tissues, leads to the proliferation of fibrous, cartilaginous, or bone-forming elements, normally present in the latter.[4] A nodule being in the latter case formed in the loose tissue of the synovial membrane, is drawn upon hither and thither in the movements of joint, and thus elongates the villous fringe in which it is developed. Eventually becoming thus pendulous, it only needs some slight violence to tear it free, and send it wandering about the joint, and this whether the process have developed fibrous, cartilaginous, or osseous tissue.[5] The irritant in this last case is believed now to be in many cases the same which leads to arthritis deformans. In the only case where, after death, I have met with such fringes bearing loose pedunculated nodules, the patient had advanced arthritis deformans of several of her joints, while the disease was only just commencing in that in which the loose body was found.[6] That similar cartilaginous bony outgrowths may spring up at the border of the joint from the encrusting cartilage or periosteum, under the same stimulus, and from here become detached by movement, is also believed, but this is probably exceptional.

The traumatic origin is also twofold. Either (*a*) a part of the encrusting cartilage[7] or of a meniscus[8] is actually torn away by violence, and becomes partly or entirely

[1] Volkmann, *Pitha-Billroth's Handbuch der Chirurgie*, Einband 5, i. p. 574.
[2] *Trans. Path. Soc.* vol. xxx. p. 353.
[3] Quoted by Barwell, *op. cit.* p. 268.
[4] Cornil and Ranvier, *Histolog. Path.* 1881, p. 447.
[5] *Ibid.* p. 470.
[6] Author, *Trans. Path. Soc.* vol. xxx. p. 353.
[7] Hase, *Deutsch. Klinik.* 1867, No. 48.
[8] Broadhurst, *Trans. Path. Soc.* vol. xviii. p. 214.

free to move about the joint or (*b*) a certain area of the encrusting cartilage, having been injured by concussion, a slow process of 'quiet necrosis,' as it was called by Sir J. Paget, takes place around the part struck, and without any suppuration the piece injured is shred off into the joint. This view, first put forward by Mr. Teale,[1] was supported by the observations of Klein [2] and Paget [3] in cases which they have recorded (*loc. cit.*) In two of these, where death followed operation, the loose bodies, consisting of a layer of cartilage with a plate of bone on one aspect, were found to fit accurately into a corresponding depression on a condyle of the femur, and there was a distinct history of injury in all. Mr. Barwell, too,[4] records cases of traumatic origin, probably in this sense also.

Finally, a case is recorded [5] in which the point of a needle was found as a nucleus of one of these bodies after its removal by operation. This had probably been the irritant in this case which had initiated the hyperplasia of the synovial tissues. Again, blood-clots are supposed to give rise on hardening to loose bodies.

The symptoms to which these latter give rise are usually distressing and unmistakable, if only one or two bodies be present. When greater numbers exist, they are less liable to produce trouble, though they can be felt very easily. When single, the first symptom is usually agonising pain during some unusual movement of the joint, in the vast majority of cases of the knee, to which this description refers. This pain is sudden, rending, and often produces faintness, and with it the limb is observed to be fixed in the flexed position immovably. This fixation generally lasts from a few hours to a day or two, and then gradually yields, the joint regaining its normal powers soon after. Such an attack is generally followed by a mild synovitis with effusion. When the latter has been absorbed, the loose body may usually be found at one or other aspect of the joint, but most frequently in the pouch over the external condyle. The pain is then explained easily, when we remember that, if such a body catch either between the ends of the bones or under a ligament, and an attempt be made to straighten the limb as in walking, the ligaments must be at once subjected to the most enormous stretching force, owing to the length of leverage and the shortness between the fulcrum and the resistance.

Such attacks are liable to recur with ever-increasing frequency so long as such a body remains in a joint, and the patient lives in constant apprehension of their occurrence, having often no means of guarding against them, and being unable to say when they will occur. Sometimes a bandage or strapping, by retaining the body in one of the pouches, may prevent such an attack for a time; but its action is always uncertain, and sooner or later the patient will call urgently for an operation for their removal. This will consist either in *direct* excision of the offending body at once, or, as recommended by Syme and Goyrand, in first dividing the capsular structures over it subcutaneously, and allowing it thus to slip out of the joint under the skin, to be removed from this some days later when the capsular wound has closed (*indirect* method). In those cases, however, where a loose body is felt in a joint, but gives little trouble, no operation for its removal should be undertaken; for, although the advance of surgery in late years in the direction of antiseptic treatment of wounds has brought with it a great diminution of risk in the operation called for here, yet the procedure must still be regarded as more or less dangerous, and from time to time, with all antiseptic precautions, joints are destroyed, as I have seen in one case operated on by a most skilful surgeon, and by the most approved methods. In such mild cases, if the body can be coaxed into a favourable position, it may be retained sometimes long enough, by a pad with a hole in it, to produce a slight adhesion, which will prevent its slipping about for a time.[6] But such adhesions usually break down sooner or later, if they ever exist, and the patient is as bad as before. It is for these reasons that the excision operations, direct or indirect, are called for eventually in many cases. As to the actual dangers of the latter, they have by no means been

[1] *Trans. Med.-Chir. Soc.* vol. xxxix. 1856, p. 31.
[2] *Virchow's Archiv.* 1864, p. 190.
[3] *Bartholomew Hosp. Reports*, 1870, p. 1.
[4] *Diseases of Joints*, 2nd ed. p. 283.
[5] Shaw, *Trans. Path. Soc.* vol. vi. p. 328.
[6] Manby, *Birmingham Med. Review*, 1875, p. 158.

exaggerated in former years. Various collections of cases have been made and tabulated, and even admitting that those taken from general literature contain their just proportion of unsuccessful cases, which is extremely unlikely, still the mortality is shown by them to be very high. Thus Volkmann,[1] among 179 cases operated on by both methods, which he had collected, found 38 deaths. Berthenson,[2] quoted by him, among 162 found 20 fatal, and H. Larrey[3] among 131 operations by the direct method gives 98 recoveries, 28 deaths, and 5 failures. Volkmann (*l.c.*), although he does not state how many of his collection were direct and how many indirect operations, states that the percentage of deaths in his list was nearly the same as in Larrey's—namely, 21·3. This is probably nearer the truth than what we gather from Berthenson's list. The largest collection of these cases, however, which has yet been made—namely, that very careful one compiled by Benndorff[4] in 1867—shows a somewhat lower mortality. Among 218 direct operations, he found 41 fatal cases, or about 18 per cent.

The mortality after the indirect method is not so high, yet in Larrey's list it stands at 12·8 and in Benndorff's at 9·9.

These figures, although placing the mortality for both operations probably far lower than it in reality is, show that, at all events, some years ago they were both formidable procedures.

But an improvement has taken place since then. Thus Mr. Barwell,[5] from a very carefully compiled list, including all the cases he could collect as occurring between the years 1860–75, finds the mortality after the direct method fallen to 8·4, and after the indirect to 2·5.

And it is probable that, if all the cases operated on during the last five years could be collected and tabulated, we should find a still greater improvement. When Volkmann made his collection of 179 cases of excision of loose bodies from the knee some years ago, and found among them 38 fatal, he little thought that in 1881 he would be able to say that he had himself opened, drained, and washed out non-suppurating knee-joints more than 200 times without one bad result.[6] The results, too, of operations on the knee for *genu valgum* lead us to hope that the great dangers of opening the joint have been almost done away with by the late advances in antiseptic surgery, and that removal of loose cartilages from the joint will be equally free from great risk. If this be so, it will not be so necessary to inquire into the relative value of the direct and indirect methods. Hitherto there has been a good deal of difference of opinion on this point. On the one hand, it has been argued from the statistics of the two operations, that the danger of the indirect was much less than the direct, while on the other a strong objection to the first method was raised on the grounds that it was frequently found impossible to carry it out, owing either to the attachment of the loose body by a pedicle, which prevented its protrusion through a simple slit in the capsule made subcutaneously, or to the difficulty of clearing a space for it in the subcutaneous tissue ample enough to admit of its lying quietly without any tendency to slip back into the joint. Thus, though in Larrey's table there were only 12·8 per cent. of deaths after the indirect method, there was 38·4 per cent. of failures, and, correspondingly, 9·9 and 23·5 per cent. in Benndorff's list. Again, in Mr. Barwell's table, though the deaths have sunk to 2·5 with the indirect method, the failures are still as high as 25 per cent. Even in Square's[7] experience, who may be said to have perfected the indirect method, though he had no loss of life, yet he had four failures in fourteen operations. It is impossible, however, for the present, to state from statistics what the inherent dangers of these procedures really amount to, and what their relative danger. It will only be possible to do this when larger series of cases are accurately recorded by individual operators operating with the same precautions as to cleanliness, &c., and by the same rules, which can be added up or contrasted with our full

[1] *Pitha-Billroth's Handb. der speciel. Chir.* Bd. II. Abth. 2. [2] *Ibid.* [3] *Ibid.*
[4] Virchow and Hirsch, *Jahresber.* 1868, ii. p. 373. Inaug. Diss. Leipzig, 1867.
[5] *Diseases of Joints,* 1881, p. 282.
[6] *Trans. of Internat. Med. Cong.* 1881, vol. i. p. 80.
[7] Quoted by Barwell, *loc. cit.* p. 282.

confidence that they embody their entire experience of the operations in question. Cases taken here and there, occurring at different times and in the hands of different surgeons, cannot fairly be contrasted or taken in the aggregate to prove anything positively. In the meantime the tendency of opinion appears generally to be strongly in favour of the direct method conducted with the strictest antiseptic precautions. Those who operate in this way now-a-days have little fear of serious complications. Thus Mr. Barwell says, 'I have excised a large number of loose cartilages, and have never experienced a failure or an untoward event.' Dr. Iverson[1] of Copenhagen, too, in urging this method with strict antiseptics, even so long ago as 1874, gives thirteen operations with only one death. Probably much better statistics could be shown to-day by the same author. Still there are those who look upon the simpler methods of bandaging and rest as a means of procuring adhesion of the loose bodies as adequate treatment for many cases, and adduce cases in support of their opinion.[2]

As to the modes of excision themselves, they may be very shortly described. The direct consists in simply drawing the skin tightly over the loose body (which is firmly fixed by an assistant at the most convenient part of the joint) and making an incision right down upon it. This being done, it will sometimes suddenly start out through the opening of the capsule, and get free. In other cases where it is attached by a pedicle, it is necessary to draw upon it with forceps, and either tear or cut through the latter. The wound being dressed antiseptically is allowed to come together, and the limb is immobilised securely in one way or other, and left so for some days until union has commenced, when it may be inspected and put up as before until quite healed. The indirect method consists in passing a broad-bladed tenotome under the skin at some little distance from the loose body, fixed firmly by an assistant. With this a subcutaneous bed is prepared for the reception of the foreign substance, by making sweeps with the knife through the areolar tissue. When room enough has been made, the capsule is incised by cutting upon the loose body, which now slips out into its bed freely, if not pedunculated. If attached, it may not slip out, or having done so may return, when the direct method must be tried. When it has been brought into its subcutaneous bed, a pad is put over the point corresponding to the capsular incision and secured there until this is healed, the outer wound being left free for any drainage that may be necessary. A number of other methods now abandoned have been in use from time to time, but need not be discussed here.

Finally, it may be noted before concluding this subject, that resection of joints has been proposed and actually practised on account of the presence of loose bodies. Thus Hueter[3] states that, in a case where the elbow contained several loose bodies which interfered greatly with its functions, he was led to conclude that a resection offered the best prospect of a useful arm. He therefore performed the operation with the best result. Similarly in the case of the ankle-joint in which a patient had been crippled for some years by a loose body, he dealt in the same way with it with a very satisfactory result.

Anchylosis.

Having now considered generally the destructive processes in the soft tissues and bones of which joints are made up, it is necessary to bestow a little attention upon the reparative processes found here.

After any form of inflammation of a joint, non-destructive or destructive, which has been recovered from, plastic material will be found in or about the articulation almost certainly. This will vary in quantity from a few flakes of lymph floating in the synovium to the masses of fibrous tissue or bone found in cases of firm anchylosis.

Lymph floating about in the cavity is usually soon absorbed when the joint is put to use once more, but sometimes it becomes moulded into those loose bodies already described (p. 355). When in greater amount, so that it forms a thin layer over the still healthy cartilages and synovial reduplications, it may remain in a more or less soft state, or become organised into a material resembling embryonic fibrous tissue. In

[1] *Brit. and For. Med.-Chir. Rev.* July, 1874. Quoted by Manby.
[2] Manby, *Birmingham Med. Rev.* 1875, p. 158. [3] *Gelenkkrankh.* vol. i. p. 265.

either of these conditions, after disappearance of the inflammation, it produces a good deal of stiffness in and about the joint, which the patient is therefore unable to flex voluntarily. If, however, forcible flexion under an anæsthetic be made, there is no difficulty whatever in tearing through the new material, whether now vascularised or not, and in restoring at all events the passive mobility of the part. As a rule, if this be done once or twice, the plastic exudation is torn and rubbed sufficiently to destroy its continuity, and the patient is able after a few days of pain, and perhaps a little swelling, to use the joint again, after which the remains of the new material are soon disintegrated and absorbed and the part regains its usual mobility.

But a very different condition results if the cartilages have been destroyed by an inflammation. When the destructive process ceases in this case (in which there is usually an external opening into the joint at one or other aspect), a quantity of the products of inflammation remain between the ends of the bones in the form of a fine-celled vascular granulation-tissue. This is now organised, the cells becoming fusi-

Fig. 70.—Section of a Knee-joint, the bones of which are united by ligamentous tissue after scrofulous disease. (From a preparation in the Museum of St. George's Hospital.)

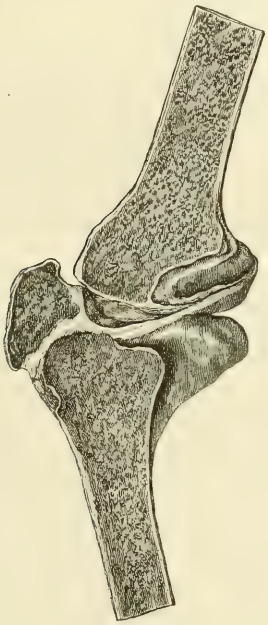
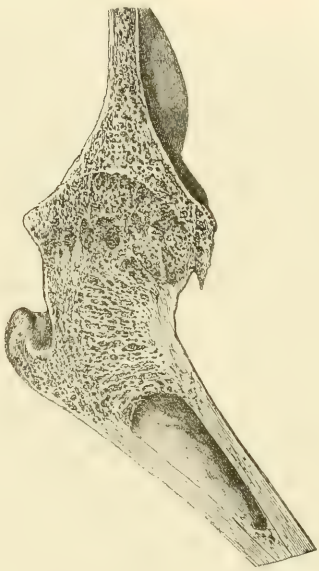


Fig. 71.—Section of a Hip, presenting complete Bony Anchylosis of the Ilium and Femur. (From a preparation in the Museum of St. George's Hospital.)



form and eventually filamentous, and arranging themselves in bundles in the direction of the small vessels developed in the material, until finally the latter is converted into firm fibrous tissue. Through this the ends of the bone may now be firmly soldered together beyond all hope of recovery of the movement of the joints, and fibrous anchylosis be produced (fig. 70). Any attempt to tear through adhesions of this kind forcibly under chloroform might possibly be successful, but would be followed by such an amount of inflammatory reaction as would only again unite the surfaces as before, if it did not lead to actual suppuration.

Again, if the cartilage be all destroyed and the bones come into contact, more or less arrest of the destructive action is usually followed by a much more elaborate reparative process. Here the inflammatory material between the softened ends becomes organised as before; but the change goes a step further, and osseous matter is deposited in the embryonic fibrous tissue, just as in the case of a fracture it is deposited in the analogous plastic material called 'definitive callus,' until the whole or part is converted into true bone (fig. 71). This *osseous anchylosis* is usually very firm, and cannot be broken down. The arrangement of the new trabeculæ is very irregular,

but otherwise the uniting medium differs in no degree from ordinary bone. In many cases the medium of union between the ends of a joint recovering after destructive inflammation, whether of the whole or part of the cartilage, is partly fibrous and partly osseous. Again, in those cases of rarefying osteitis of the ends of bones, in which the surfaces of the joints are invaded by the spongy granulating medulla without suppuration, it is simply a question of the inflamed medulla of the two affected bones coalescing and becoming fused into one mass of spongy material. If repair now set in, we have the same organisation of this mass into fibrous and eventually osseous tissue as that mentioned above, and the most perfect example of bony anchylosis results that can be met with. Here, too, the process is precisely analogous to that taking place in the repair of fractures, a 'simple' process in this case where there has been no suppuration and no external wound. It may be added that in inflammation of joints every shade of fixation, from that due to the mere effusion of a little fibrinous material between the articular surfaces, or the planes of the tendinous structures around, to that complete fusion of the ends of the bones just described, may be met with in different cases. The diagnosis of the particular condition present in any given case will be based upon the total of the clinical history from the beginning.

Nervous or Hysterical Affections.

Any essay on joint diseases would be incomplete which did not take into consideration those cases familiar to most surgeons, in which one or more of the symptoms (subjective or objective) of a diseased articulation are complained of, but where careful examination fails to detect any evidence of structural change, where there is in short a 'mimicry' of the different joint affections without any local disease.

The subject must be very briefly dealt with here. It will be found treated of specially and very ably by Sir J. Paget in his 'Clin. Lectures,'[1] and also by Jolly indirectly in his essay on 'Hysteria.'[2]

This *neuromimesis* of joint affections is characterised, as a rule, by the onset of severe pain in some articulation which, from the patient's description, is at first sight remarkably like that accompanying one or other of the diseases of the part. The patient may complain at the same time of some of the other subjective phenomena of true disease, such as a sense of heat and tenderness on pressure or starting of the limb. The resemblance may be further heightened in a few cases by slight swelling, or, more frequently, by deformity; the limb assuming the position commonly observed in disease. All this may be before us in any given case, and yet no evidence of true structural change in the joint be present to the most careful and skilful examination.

Such cases are of frequent occurrence, especially among the higher classes, of whom Sir B. Brodie says, 'that at least four-fifths of the female patients who are commonly supposed to labour under diseases of the joints, labour under hysteria and nothing else.' But among the less favoured classes they are by no means uncommon. It is, therefore, most important that the whole question of neuromimesis should be carefully studied; firstly, because we might otherwise easily be misled into a diagnosis of local disease where none exists—and it should be remembered that not very long ago, when these conditions were less studied, serious operations, and even amputations, were undertaken in cases where local disease was suspected, but where the part removed was found perfectly healthy—and secondly because, if we accepted such statements as those of Sir B. Brodie too lightly, we might fall into the almost equally unfortunate error of overlooking real disease at a stage when it was most within the reach of well-directed treatment.

Neuromimesis is met with at almost any period of life from infancy (Smith, *l.c.*) to advanced age (Paget, *l.c.* p. 194). It is, however, most common in the decade which follows puberty (Jolly, Paget). It is much more frequent among females than males, though by no means rare with the latter. All classes suffer, but the wealthy more than the poorer. In either it is met with among those disposed to functional

[1] Paget, *Clin. Lect. and Essays*, 2nd ed. 1879.
[2] Jolly, *Ziemmsen's Cyclop. of Pract. Med.* vol. xiv. p. 473.

disorders of the nervous system, or belonging to that habit commonly spoken of as neurotic, using the term in its ordinary signification. Of the abnormal condition of the nervous system which gives rise to the neuroses, little or nothing is known. We only know from a general study of its symptoms that it can be transmitted hereditarily or acquired, partly by sensory irritation, and partly from the effects of an abnormal state of the blood. It develops itself most powerfully where both these influences combine. It will be well then, in any case in which we suspect the condition before us to be one of 'nervous mimicry,' before examining it in relation to the various symptoms which we look for in real disease, to consider the following questions relating to the patient's general history.

1. Has there been insanity, epilepsy, paralysis, eccentricity, or strong emotional disposition manifested among the sufferers' relations of the preceding generation? Were their parents aged at the birth of the patients?

2. Have the latter been subjected to any great emotional disturbance, chronic or acute? *e.g.* such as that of fright, jealousy, disappointment from failure in life, or mortification due to real, imputed, or supposed dishonour. Have they lately gone through excessive mental exertion or borne the strain of night-watching, especially where the affections have been engaged? During the strain there is little liability to attack, but when this has relaxed, and the stimulus of excitement is gone, the patient yields.

3. Have they lately gone through any physical over-exertion of an unusual kind, prolonged or brief, or been subjected to privations? Has there been any over-stimulation of the generative organs, due to masturbation or the like. Are they anæmic, or suffering from any of the chronic affections of the generative organs? The very grave diseases of these parts, such as cancer, have little significance here.

4. Finally, if constitutionally neurotic, have they been in a position to see others suffering from those affections with which they believe themselves to be afflicted; in such a position, in short, as to call forth the involuntary imitation?

Answers to these questions will furnish us with evidence as to causes hereditary, mental and physical, engendering the general neurotic state, and also that particular phase of it manifested in imitation of morbid phenomena.

Turning, then, more particularly to the latter, as exhibited in the joints, it will be found most convenient to examine in each case how far the symptoms complained of are consistent as compared with those present in true disease.

The affections of the joints most frequently imitated are the more or less acute inflammatory, whether simple or strumous; the gouty and rheumatic less often. Any of the subjective symptoms of these, and some of the objective, may have to be considered in mimic cases, whether pain, tenderness, heat, throbbing, stiffness, deformity, swelling, or wasting.

Taking the first of these—*pain*—it may be first broadly stated that in cases of mimicry it is complained of as severe out of all proportion to anything subjective or objective said or found to be the matter with the joint. The patient usually represents it as extremely severe, and yet, when engaged in conversation or otherwise diverted, is palpably but little affected by it. It is moreover generally referred to the more superficial parts of the joint. If asserted to be increased by movement, an inconsistency is soon apparent in the exaggeration of the symptom. That gnawing burning pain complained of by those who are suffering from ulceration of cartilage and slow disorganisation of a joint is also mimicked; but, in that case, the objective symptoms, such as heat, swelling, œdema, &c. are absent, and under chloroform the movements of the joint will be found free and unaccompanied by any sensation of friction. Sir J. Paget suggests as a sign that pain is due to real disease; that, if chloroform be given, the joint returns to rigidity immediately on the first dawn of sensibility as the narcotic passes off; while in neuromimesis the joint is only again rendered stiff when the patient has become fully conscious of all his surroundings and condition.

The temperature of the affected part must be very carefully studied, for here lies one of the greatest aids to a correct diagnosis. In the first place, it should be noticed whether the joints on both sides have had an equal external covering for some time before

our examination. If one have had only the usual clothing, and the painful one have been swathed in dressings or bandages, the former may be much cooler than its fellow, and without care we may thus be misled. But, if both have been uncovered for a considerable time, and subject to the same external conditions, it will be usually found that in mimic cases the temperature of the painful joint is no way affected, or, if slightly increased, that the pain complained of is out of all proportion to the increase. The affected joint, on the other hand, may be, and often is, even cooler than its healthy fellow, which is strong evidence against disease. In true inflammatory disease there will in most cases be a sufficiently marked elevation of temperature to indicate the condition. The rise may be estimated by the palm of the hand, if the latter have been, as it were, trained to such work for a long time, and if a careful comparison be made between the limbs of both sides, and the surface of the rest of the body. In doubtful cases, the surface thermometer may be useful, if used with due care. The fact that with real disease one part alone of a joint may be hotter than another should be remembered, for this could not be the case with pure neuromimesis. Flushings and transient rises of temperature alternating with periods of normal heat in a joint do not indicate local disease. If this were present, the part should be constantly overwarm. Patients will sometimes complain that, though the part is cold during the day, it is hot and burning at night. If gout be not present here, it is most likely a case of neuromimesis. This diagnosis will be strengthened if the part during the day is cold, and generally of a purplish mottled appearance.

In cases where very severe pain is complained of, with possibly other objective signs of local mischief, the absence of any general rise of temperature of the body may also help the diagnosis. For with true disease bad enough to produce very acute pain, deformity, &c., there would probably be some general disturbance too. But frequent observations must be made of the temperature of the suspected joint, and of the whole body, and the information thus obtained be taken with all the other evidence, otherwise error is likely to arise.

The tenderness complained of as very great, on the slightest touch of the joint, is also to be suspected if it be accompanied by neither heat, swelling, nor redness. It will usually be found, in such cases, that, if the patient's attention be diverted, the part may be very freely handled without complaint, but that when a question is again put concerning the joint, the slightest touch is exclaimed against. This tenderness is usually felt only in the superficial parts, deeper pressure producing no increase.

Of stiffness and deformity, it should first be noticed that, if very acute suffering be complained of in a joint, lasting for weeks, and the part remain extended and movable, it is highly improbable there is any local disease present, unless it be rheumatic or gouty.

Sometimes, however, in cases of neuromimesis, the joint may assume a position usual with real disease. Thus the hip may be flexed, adducted and inverted, and thus fixed, great pain being complained of on attempts to straighten it. But here the absence of all heat, swelling, redness, or general fever, always present where in real disease the limb has recently assumed this position, will probably guide us to a right conclusion, together with the history of the case, hereditary and personal. In such instances, too, the limb may be often involuntarily or passively relaxed, without any movement of the pelvis, if the patient's attention be closely engaged on something else, which could never occur with real disease. It should also be noted that, where mimic disease has been accompanied by an unusual position of the joint for long periods, even for years, no true deformity of the part has been found after death. This is not the case where true disease has been present—where, for instance, more or less alteration of the surfaces of the bones is usually found, with or without sub-luxation in greater or less degree.

As to swelling, it may be said never to accompany the simple mimic affections. It may, however, have been caused (where the latter have been mistaken for true local disease) by stimulating outward applications, the effects of which last often for a considerable time.

Wasting, in the true sense of the term, is not met with in mimic disease. That

rapid loss of tissue observed about a joint truly diseased is never seen here. Disuse (if the other limb be still used) may produce leanness on the painful side as compared with the opposite; prolonged and firm bandaging may do the same, or the wearing of elastic coverings; but the loss of bulk is usually but trifling, and in clear contrast to what might be expected were disease present in a degree equal to the patient's belief, or in correspondence to other symptoms.

It is only by the careful consideration of all these subjective and objective symptoms, together with the patient's family and personal history, that we can safely come to a diagnosis in this very important class of cases. For further observations on this subject the reader is referred to the essay on HYSTERIA.

AFFECTIONS OF THE HIP.

The joint which claims our attention first is the hip; not only on account of its size and importance, but also because it is one of the commonest seats of articular disease. We shall consider the latter as met with here in the order already followed in the section of this article devoted to general pathology.

Simple acute synovitis is not as commonly met with in the hip as in other joints, owing to the great depth of the soft tissues which protect it from external influences.

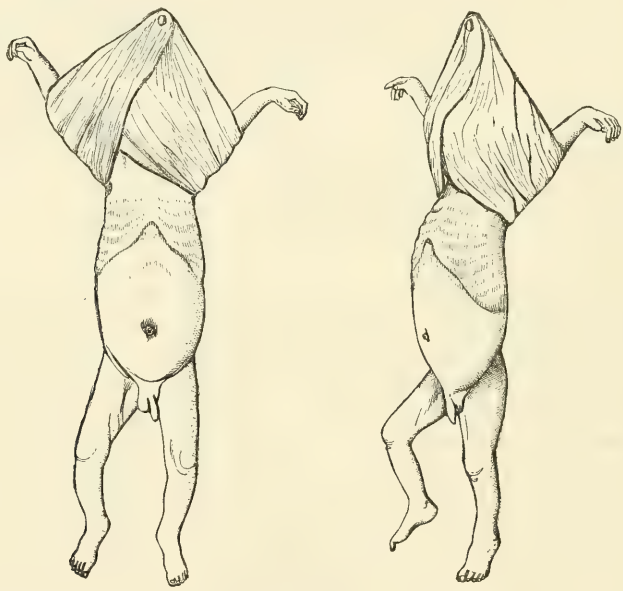
The pathology of synovitis having been already discussed (p. 334), we need only add as regards this particular joint, that here it is usually the result of over-exertion and exposure combined acting on constitutions not robust.

The subjective symptoms observed are stiffness and heat at first, soon succeeded by throbbing and pain, not only in the joint itself, but also in the knee, though the latter be perfectly sound—a fact explained by the connection between the two joints through the obturator nerve. This pain is much aggravated by movement or pressure over the joint in front and behind, and causes limping very early, and later prevents walking altogether.

Objectively we find swelling in two situations—viz. over the front and back part of the joint where the tenderness is most felt, and where fluctuation may be occasionally discovered. The next most striking symptom is the position of the limb. If the patient be young, and the inflammation recent, the latter will be markedly flexed, abducted, and somewhat everted (fig. 72). This position is brought about as follows. The synovial membrane and overlying capsular structures are now inflamed, swollen, and tender. That portion of the capsule normally tense in the straight position of the limb—viz. the anterior incorporated with the ileo-femoral or Y-ligament—is, as we might expect, the most in need of relaxation. The patient, therefore, flexes the thigh involuntarily to relax the tension which adds to its tenderness. The inner limb of the Y-ligament and horizontal posterior fibres too are relaxed for the same reason by eversion, and the outer part of the Y and upper part of the capsule by abduction. In short, the joint is placed involuntarily in the position most calculated to adequately relieve the various strong parts of the irritated and swollen synovial and capsular structures (fig. 72). In this position it is fixed by muscular action, lest any rubbing of the sore surfaces should take place; and all attempts to move the limb are resisted strongly, the only change admitted of being that of the pelvis, which now moves as a whole with the thigh. In standing the patient will now be obliged to lower the pelvis on the affected side to make up for the shortening due to flexion and abduction of the limb, and admit of the foot resting on the ground. But when in bed he will probably lie on the affected side more or less in order to have the support of the bed for the now flexed and abducted limb, whose every movement is painful. If asked to lie on the back, he will object if his case be acute on account of pain; but if persuaded the limb will maintain its characteristic position. Any attempt now to bring it parallel with its fellow results only in movement of the whole pelvis, the angles between it and the axis of the limb remaining fixed. Thus abduction into parallelism can only be effected by lowering the pelvis on the diseased side. This will of course bring the limb below its fellow, so that it now looks longer than the latter, as it lies in contact with it. At

the same time the knee can only be brought down to the bed by rotation downwards and forwards of the pelvis on its transverse axis, accompanied by great increase of the lumbar curve of the spine (see fig. 75, p. 370). The greater the flexion of the thigh on the pelvis, the greater this lordosis. This characteristic position of the hip-joint with early synovitis is well seen in fig. 72, copied from a photograph of a child's body into whose hip-joint I had forcibly injected water by means of a syringe with a screw piston, after rigor mortis had passed off, thus repeating an experiment made long ago by Bonnet. As the fluid was slowly

FIG. 72.—From a photograph of the body of a child into whose right hip-joint I had injected water, while the body was suspended from the arms after rigor mortis had passed off. While the water was being forced in through the pectineal eminence of the pubic bone, by means of a screw piston, the right limb rose slowly and easily into the position in which it was photographed (namely flexion, abduction and eversion), and remained so without any support until the photograph was taken, not altering its position in the least until later, when the water was allowed to escape from the joint, when it at once fell to its normal position. How far it deviated from this during injection will be seen if a line be drawn down the centre of the body through the ensiform cartilage, umbilicus and symphysis pubis in the left-hand figure.



forced in through a hole bored through the ileo-pectineal eminence of the pubic bone—the body being suspended by the arms—the limb gradually rose without the slightest assistance into the position shown in the engraving. Thus it remained until the water was allowed to run out, when it slowly sank down beside its fellow. This experiment illustrates without any dissection what parts of the capsule of the hip are most tense and unyielding, and which are the reverse. And this, on the other hand, indicates what parts require most to be relaxed when in an inflamed, swollen, and tender condition. The theory of muscular contraction, the result of reflex irritation through the nerves supplying the hip-joint, is thus shown to be unnecessary.

The general treatment of this synovitis of the hip will be that sketched already (p. 335). The only special points to be noticed here, as regards the hip, are the modes of fixing the joint so as to give it complete rest. If the case be severe enough to require more than a few days' rest in bed, with free leeching and hot fomentations, the question here arises: in what position should it be immobilised—as it is, flexed, abducted and everted? or, brought down forcibly as nearly to a straight line as possible? Hitherto it has been almost universally held that the limb should be straightened rapidly, if necessary forcibly, under the influence of chloroform, and so fixed by some

appliance; and the general practice has been in accordance with this view. But of recent years the opinion has been gaining ground, that perhaps what is gained by at once straightening the part, and so the easier fixing it and preventing deformity subsequently, may be lost by bringing the joint at once into a position which is clearly *not* that of greatest rest, seeing that it was the desire to obtain the greatest relaxation of the inflamed structures which led the patient involuntarily to flex, abduct and evert the limb in the first instance. And practice has of late been modified by this view. Formerly the treatment followed in these cases was to give the patient chloroform, and then forcibly bring down the limb, fastening it thus to a long splint running from the axilla to below the external ankle. From this splint extension was made by a collar or strapping running from the ankle to the forked lower end of the splint, while counter-extension was made by a perineal band reaching to the upper end, which was pierced to receive the ends of the latter. Or, the straightened limb was put up in a plaster of Paris or starched bandage. The latter had the disadvantage of interfering more or less with the use of local antiphlogistics, and for this reason were not used as much as Liston's long splint. Of late years the treatment with many has been rather to bring the limb parallel to its fellow, slowly and gradually, so as to disturb the involuntary adjustment of the inflamed ligaments as gently as possible. This is usually effected by one or other form of gradual extension with a weight—that is, either the weight is made to pull at once in a direction parallel to the sound limb, or, as Mr. Marsh [1] proposes, is so contrived as at first to exert its force in the direction of the affected thigh, and then gradually change into the more direct pull downwards. If the first of these methods is chosen, it is best carried out by means of strips of sticking plaster running down each side of the leg, and fixed thus to the latter by a turn or two of plaster and a bandage. The ends coming below the heel are fastened to a cord, which passes over a pulley at the end of the bed, and is attached to a weight of one pound and upwards. The plaster is kept from pressing upon and chafing the ankle by the insertion between the strips of a small piece of flat wood, which keeps them apart. With this appliance the limb may in many cases be brought down to a straight line, in a comparatively short time, and without any violence to the joint. It has the disadvantage with children that they are apt to evade the steady pull of the weight by twisting the body until the limb, and not the body, lies in the direction of the pull from the weight. This difficulty may to some degree be met by arranging sandbags at either side of the child's body, or by using a perineal band fastened to the head of the bed. Or, if there be any tendency for the child to slip down to the end of the bed, the foot of the latter may be raised a few inches from the floor, when the weight of the patient will be the counter-extending force. Mr. Marsh's mode of extension is to begin by placing the pulley high enough over the bed to lie in the axis of the thigh as the patient rests on his back. If the pull is made in this direction for a short time, it is found that the limb has come somewhat down. The pulley is now shifted a little nearer to the foot of the bed, and the extension made thus a little more directly downwards. In this way by degrees the position of the part is restored before long.

Extension, however practised, is usually comforting to the patient when once applied. It steadies the joint, and counteracts the action of the muscles. If the case be one of very acute synovitis, it may be necessary to use an anæsthetic for the application of the plaster and arrangement of the child in bed; but once this is completed, but little suffering will be noticed.

But other appliances besides this extension may be employed to keep the joint at rest, and at the same time to bring down the limb gradually. One of these is Thomas's splint, which is as useful in these simple acute cases as in those more chronic, to be alluded to presently. As this splint is in more general use for the latter, its construction and application will be considered with them. It is particularly useful in the later stages of the affection, as it enables the patient to get about in the fresh air, when otherwise debilitating confinement might be necessary.

[1] *Brit. Med. Journ.*, July, 1876.

Acute suppurative synovitis of the hip is so rarely met with in the simple form produced by external influences, that its consideration may be left over until we are studying the diseases produced by constitutional causes, where it will often be found.

The *simple sub-acute and chronic* forms, too, although doubtless quite distinct as to causation, are so like in history and effects, and in the necessary treatment to those affections induced by the so-called strumous diathesis, that they need no description for themselves here; enough will be said of them practically in discussing the latter.

The synovitis of the hip produced by those diseases we have grouped together under the common head of *pyæmic* or *septic* (p. 337) may be either acute, sub-acute, or more rarely, chronic.

In the first instance the symptoms (p. 337) develop very rapidly, and the limb quickly assumes the characteristic position of acute synovitis described above (p. 364). But this soon becomes modified, as a rule, in bad cases. The flexion is the same, or even increased; but eversion and abduction soon give way to inversion and adduction, for the following reason. This acute septic synovitis, usually of the suppurative form, is essentially a destructive inflammation; it leads rapidly to more or less softening of all the capsular structures by the contact of its irritating products, now distending the latter, and primarily leading to the assumption of the first position described, all their fibres being now equally on the stretch. As the inflamed capsule then commences to soften, its weakest part yields first, *i.e.* the posterior inferior. This now admits of more flexion still, for the greater relaxation of the strong anterior fibres. The horizontal posterior fibres, which in the distended condition of the capsule help in the eversion, are the next to stretch, admitting of inversion, which is now the more possible as the Y is relaxed by flexion, and its inner limb has no strain to be taken off by eversion. Finally, the upper and outer anterior fibres yield, and adduction then takes place. All this time the muscles are involuntarily placing the limb in the best position for relieving each remaining part of the capsular structures of tension, and thus fix it at last at flexion, adduction and inversion. The flexion in these cases is sometimes extreme, the knee rising occasionally nearly to the umbilicus. If this be so, the head of the femur will lie nearly out of the acetabulum, below and behind, resting in great part upon the softening capsule. If the latter now give way at its weakest part, which is just there, and the ligamentum teres have been equally softened, the least jerk, even of a patient moving in bed, is sufficient to dislocate the head of the bone out of the acetabulum on to the dorsum ilii. Some time ago a striking case where this 'dislocation by distension' of Volkmann had occurred, came under my care at University College Hospital. During typhoid fever rapid effusion took place into the hip-joint of a hitherto healthy ploughboy; the limb soon became acutely flexed and adducted, and by some movement unknown to those about him, the femur became dislocated as he lay in bed. The appearance was typical, and the shortening extreme. Six weeks later, during convalescence, I reduced the dislocation by manipulation under chloroform and without difficulty, and found the surfaces of the articulation apparently quite healthy on moving the joint. This movement of the bone, however, caused the head of the bone to slip out again immediately. I replaced it once more on the spot easily, and so retained it, the boy making a complete recovery. Several months later he returned from the country to show himself, when I found the limb of normal length, straight, and, with the exception of stiffness about the joint, quite as the other. In this case the strong resistance of the anterior structures of the joint, apparent when the dislocation was reduced, in the flexed position of the limb, was not overcome forcibly while the patient was under the anæsthetic, but was treated by gradual extension, lest the remains of the capsule should be injured. The result showed that they stretched in the course of a few days, while retaining the head perfectly *in situ*. There was no evidence of abscess from beginning to end of case.

Acute septic synovitis of the hip should be treated on the general principles already alluded to (p. 339). But here it will probably be better to prevent the flexion, adduction, and inversion from the first, if possible, by extension or other methods, rather than let the limb have its own way of relieving itself and trust to extension later on.

For here the process is so rapid that dislocation may occur very early, as described, while simple extension with a small weight would prevent this, besides keeping the part at rest. As long as the first position remains one of flexion, abduction, and eversion, there is no fear of dislocation, and the case may be treated with the ordinary local and constitutional antiphlogistics, with rest in bed. But as soon as adduction and inversion are commencing, extension is called for. Later on, if the case be only then seen for the first time, extension will be called for in either case, unless dislocation have already occurred, when it could do no good without previous reduction.

If in the early stages of this affection distension of the joint be very apparent, with fulness and fluctuation, in front and posteriorly, the effusion, which may be serous or purulent, should be at once aspirated from behind. This operation may be repeated several times at short intervals, if required. But, if this should fail to check the rapid advance of the process, it is best to make a free incision into the capsule from behind, and insert a drain-tube. The incision here should be parallel to the posterior border of the great trochanter and about from an inch to an inch and a half distant from it. Here the capsule is easily reached, opened, and drained. If complete disorganisation of the joint should be found at the time or should supervene, the incision can easily be prolonged and converted into one suitable for excision (see Excisions). During the whole operation the strictest cleanliness should be observed, one or other of the antiseptic dressings being subsequently used to the end of the case.

The *sub-acute* variety of this septic synovitis of the hip will differ from the last simply in degree. Here the limb will also assume one of the positions described according to the stage of the disease, but softening of the structures in the joint does not take place to the same extent. The affection, however, is apt to recur at varying intervals, *e.g.* in gonorrhœa and rheumatism, and may run on into the chronic variety. The general treatment here will be the same as in the last form, but there need be no hurry about aspiration or incision, as the fluid may readily be absorbed, and leave behind no damage to the joint.

The *chronic* form differs so little except in its ætiology from the chronic strumous affection, that it need not be described separately here, the course of the disease and the treatment called for being practically the same.

Syphilitic disease of the hip is not commonly recognised, although not unknown in one or other of the forms described already. The epiphysary affection met with as a consequence of congenital syphilis has already been alluded to as far as necessary at present. The whole subject calls for much wider study before the exact position of this class of affections can be distinctly defined.

Strumous disease comes next as one of the commonest affections of the hip-joint. The general pathology of struma has already been briefly alluded to (p. 342), the local condition alone remaining to be considered. This may have its starting-point either in the head of the femur, the acetabulum, or the synovial membrane. And though exact data bearing upon this point are wanting, it is probable that this is about the order of relative frequency. When the head of the femur is alluded to here as the commonest starting-point, it should be understood that the growing epiphysary line is meant. The earliest evidences of a morbid process here appreciable to the naked eye are found in the form of patches of osteo-myelitis granulosa, usually caseating in parts, bounded on one aspect by the epiphysary cartilage, and on the other by the cancellous tissue of the bone, unless the process have started actually at the periphery of the epiphysal plane, when a third boundary will be formed by the periosteum for a variable distance. A good illustration of this is seen in a wax model in the Museum of University College, No. 796, showing the head of a young femur in section, where the disease is just commencing. The nature of these granulating patches have already been discussed (p. 342), the results of the process of which they are the earliest expression remain to be considered. Wherever it starts from, the process will eventually spread either to the encrusting cartilage or to the periosteum of the neck, unless it terminate in early recovery. In the first case the cartilage will be destroyed in the way already described (p. 350), and the disease become general

in the joint. In the second the cartilage may completely escape a direct attack, the disease spreading instead over the whole surface of the epiphysary plane, until a soft layer of granulation-tissue is interposed between the head of the bone and the neck. If this tissue now degenerate, the head is completely separated from the shaft, and is only fixed by the ligamentum teres.[1] This will account for those cases in which during excision the head is found perfectly loose in the joint unattached to the neck, and probably also detached from the ligamentum teres. Again, the process may commence excentrically, and spread only along one part of the border of the epiphysary plane under the periosteum and its synovial covering. Here it may provoke a plastic exudation, uniting the femoral and capsular layers of the latter for some little distance around. The softening process may then spread through this area into the extra-capsular structures, without involving the general joint-surfaces at all. Arrived outside the capsule, the granulation-tissue may soften and give rise to a cheesy abscess, which, on reaching the skin, may burst, leaving a track leading down to the diseased bone, but not into the synovial sac, the two layers of the latter being united around the sinus. The pus in such cases usually travels backwards and outwards, pointing not far from the trochanter, but internal to and below it. Such cases are puzzling to the surgeon. His probe passes down to diseased bone in the neck, and yet he can satisfy himself by the movements of the joint that neither the articular cartilage nor the general synovial membrane is involved. Such a condition of things must, however, be regarded as the exception. Usually the inflammatory process having reached the surface of the neck, spreads generally over the whole synovial tract of the joint, producing the typical strumous synovitis.

Now when the disease commences in the acetabulum it goes through phases precisely analogous. Beginning in the growing line of the epiphyses, it may spread in exactly the same form, either through the cartilage directly into the joint, or run along the synovial tissue in the cotyloid notch, to open eventually outside the capsule, leaving the interior intact; but this is rare. Finally, it may, with or without extensive damage to the joint, spread towards the pelvic aspect of the acetabulum, and eventually form an abscess there. The latter may then secondarily make its way either into the joint through the diseased epiphysis, macerating the bone and giving rise to the formation of sequestra (fig. 80), or under Poupart's ligament into the thigh, simulating psoas abscess, or into the ischio-rectal fossa.

If the diseased process start in the synovial tissue, we find its first traces in the abundant loose tissue of the cotyloid notch, which is seen to be gradually converted into soft granulation-tissue, as already described (p. 342). This pulpy change then extends to the rest of the synovial membrane. With it there is effusion into the joint, as a rule usually moderate in amount, and only mildly inflammatory. If the granulation-tissue thus formed caseate, as it frequently does, and soften, the products will make their way just as often in a direction away from the joint through the capsule as inwards, affecting the bone. If an extra-capsular abscess be thus formed, it may actually save the latter. But if the caseation progress towards the joint, the latter is practically converted into a large caseating abscess, in which the bone is soon deeply implicated. For instance, the converse of what was mentioned above may occur—namely, the inflammation may now attack the growing epiphysary lines of femur or acetabulum, and thus sever the head from the neck; or the three bones of the acetabulum from one another, thus spreading into the pelvis. Finally, it may destroy both the surfaces of the joint alone by direct irritation.

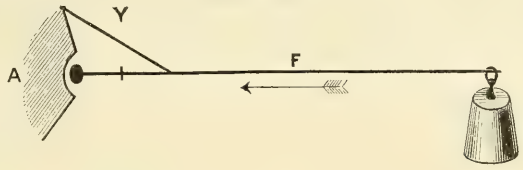
The question now arises, Is it possible to diagnose between the affections arising in these three situations? If this question refers to the earlier stages, it may be answered in the affirmative; at all events as regards the femoral and synovial forms.

When disease is early and still limited to the head of the bone, the only evidence of its existence may be a slight and hardly painful limp, with perhaps a tendency to

[1] It is stated by Hyrtl that the vessels of the ligamentum teres do not communicate with those of the cancellous substance of the head of the bone, and consequently that the nutrition of the head does not depend upon them.

a little flexion of the limb when in repose. Examination so far will show neither heat, tenderness on moderate pressure, redness, nor fluctuation. The limb may be freely flexed and circumducted by the surgeon without producing pain, and no roughness of surface will be found. Plainly, then, there is no synovitis present, with its inflamed and tender surfaces rubbing one over the other; the capsule then is intact still. If, however, the trochanter of the affected side be pressed towards the acetabulum, or if the knee be struck in the direction of the axis of the femur, pain is at once felt in the joint. The fact is, that it is only when the diseased part of the bone is pressed upon that pain is produced. Thus throwing the weight of the body upon the head will strain the inflamed bone at the epiphysary line, and cause the

Fig. 73.

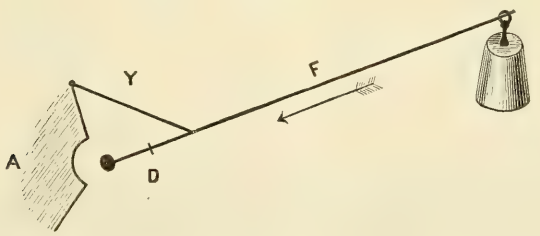


A represents the acetabulum; Y, the ileo-femoral ligament and strong anterior part of the capsule; F, the femur. The head is here resting against the acetabulum, pressed into it by the weight of the limb acting on the Y as a fulcrum; the stroke across the neck represents the area of disease.

pain which finds its expression in the wince or limp of the child in walking. This wincing is also observed if the limb be gently over-extended, the head being thus thrust against the acetabulum by the leverage of the femur acting on the Y-ligament and the tense anterior part of the capsule as a fulcrum (see fig. 73). It is for this reason that the patient involuntarily flexes the thigh somewhat to relax the latter a little, and so relieve the pressure on the head due to the weight of the limb acting on the same lever (fig. 74).

Now, if synovitis were present, even supposing we were unable to detect either heat, redness, fluctuation, or tenderness on pressure, we should still find that the patient had involuntarily fixed the joint to avoid any movement of its inflamed surfaces one over the other, and if passive flexion or rotation were attempted, would resist voluntarily, with expressions of acute suffering. The thigh would be fixed in

Fig. 74.



Letters as in the last fig. D represents the diseased area. Here the limb is supposed to be flexed in order to decrease the pressure of the head against the acetabulum and so relieve the strain on D; of course the head is only theoretically withdrawn from the latter.

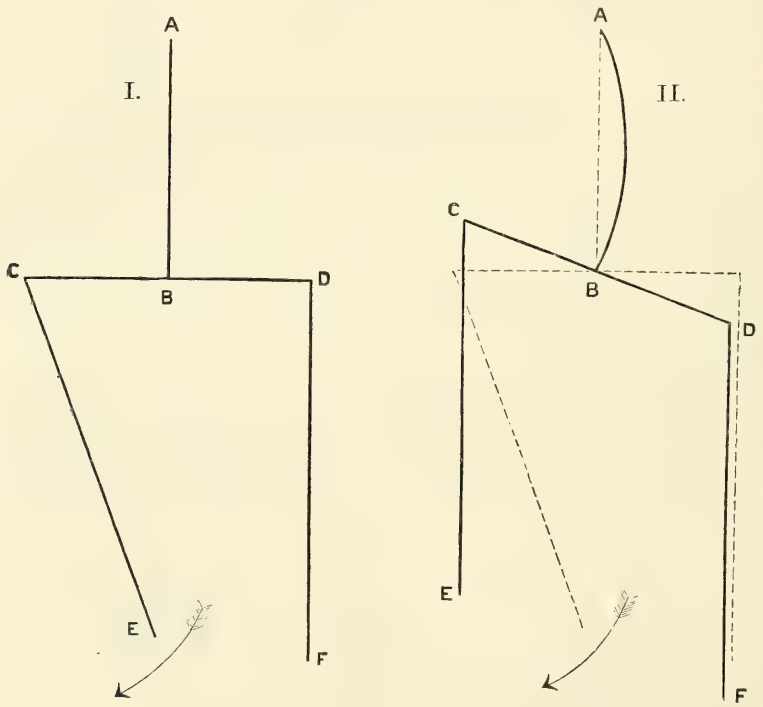
the characteristic position of synovitis (fig. 72). These points will serve to distinguish the two conditions from one another as long as they are distinct.

The diagnosis of the femoral from the acetabular affection is, however, most difficult in the earliest stages, if not impossible. Fortunately it is not as important to determine which of the bones is the starting-point of the disease as it is to make out whether the latter is commencing in the head of the femur or synovial tissues.

So much for the earliest manifestations of the strumous affection. When the changes already mentioned of caseation or softening of the granulation-tissue have affected the joint surfaces generally, the relations of parts soon become materially altered, and afford very plain evidence of what is going on. In the first place, all the evidence of subacute synovitis in the stage of effusion and softening will come on—

heat, tenderness, and swelling, with flexion, adduction and inversion, &c.; the patient in standing will have the knee of the affected side carried across, above that of the sound; the toe will rest on the ground, with the heel drawn up. If in bed, he will now lie on the sound hip (compare p. 363), with the other knee drawn up and resting across the healthy thigh on the bed; the fold of the nates will be gone. The pelvis, whether the patient is standing or lying, is raised on the affected side (fig. 75, II.) This is simply due to the desire to bring the limb, strongly flexed and adducted as it is, into a direction more or less parallel with the sound one for convenience sake. If A B represent the spinal column, C D the transverse axis of the pelvis, C E the affected, and D F the sound limb, the angle B C E being a fixed one, any movement in the direction of the arrow in order to bring C E parallel with D F must have the effect of raising C, and with it that side of the pelvis (fig. 75, II.) At the same time D

FIG. 75.



(I.) A B, the spine; C D, the transverse axis of the pelvis; B C E, the fixed angle of the diseased side. (II.) In bringing C E parallel with D F, the angle B C E remains as before, but that side of the pelvis is raised, and B D F is opened. In order to keep A perpendicularly over B, the lumbar spine A B has had to curve.

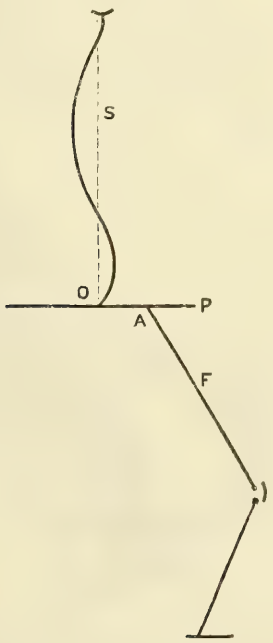
will be depressed, and the angle B D F opened, there being no fixation of this joint. The consequence is an apparent shortening of the diseased limb as compared with its fellow, although C E actually remains of the same length as before. It is now parallel to D F, but is on a much higher level, so that only the point of the foot can reach the ground. And further, as a consequence of this raising of the pelvis on one side, a certain amount of lateral curvature of the lumbar spine is produced towards the opposite side. This will be easily understood by a glance at fig. 75, II. If the spine, A, were a rigid pillar, fixed firmly to the pelvis, represented by the line B, it would now slant away from the perpendicular. But being flexible, the patient involuntarily brings the upper part of it into the erect position, with the result of creating a curve below, A B.

Another result of the fixed position of the joint is seen on the spine when the patient stands up, or when, lying in bed, any attempt is made to correct the flexion of the thigh. This is the antero-posterior curve of the lumbar part of the column

produced by the rotation downwards on its transverse axis of the pelvis as it follows the limb (see figs. 76, 77). Here it will be seen that the angle P A F is the same in both conditions of the limb, representing the fixed joint, while P O S has opened considerably, indicating the bend in the lumbar spine away from the perpendicular, S O.

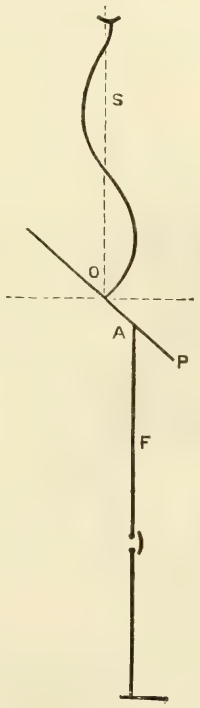
The next change in the affected limb is real shortening. To estimate the amount of this, which is important, it is best to place the sound limb in as nearly the same position as the other, and then measure from the anterior superior spinous process of the ilium to the lower border of the patella and to the inner malleolus. What the amount of shortening will be depends upon several points. If the limb have from the first been kept in the extended position, the head will simply crumble away slowly, and then the neck, until finally the trochanter comes to rest against the acetabulum, which has become simply flattened, or in some cases a little deepened by the destructive process. In such a case the shortening, measured as above, will be but slight,

Fig. 76.



S, the spine; O P, the antero-posterior axis of the pelvis; F, the femur, in the position of flexion owing to disease; A, the fixed joint.

Fig. 77.



Letters as before. Here the thigh has been brought down to the same plane as the other. P A F remains the same, consequently P O is altered in direction, and the lumbar curve is much increased.

probably under three-fourths of an inch in a child. If, on the other hand, the limb have been left to itself from the beginning of the softening process, and have consequently become strongly flexed and adducted as described, the carious head rubs against the upper and posterior border of the acetabulum. Then not only does the head, now half out of the acetabulum, crumble away, but also the corresponding part of the latter, until finally there is nothing to hold the thus flattened surfaces, and the head slips on to the dorsum ilii, producing very considerable shortening even up to two inches or more. In this we have an example of the 'dislocation by destruction' of Volkmann (conf. p. 371). In such a case, unlike the dislocation by distension (p. 366), there would be no hope of achieving much by reduction of the dislocation, the form of the acetabulum having been altered, so that it could not retain the head

even if replaced. Before very long, too, the remains of the cavity are filled up with plastic matter, and the depression is obliterated (fig. 79).

From all this it will appear that strumous hip-joint disease might be divided roughly into three stages, (1) that of simple inflammation without shortening, (2) that of shortening without dislocation, (3) that of dislocation. Another division, purely clinical, but nearly corresponding to the pathological just given, is also useful for the student. It indicates, also, some very important features in the disease mentioned above. This is (1) the stage of flexion with abduction and eversion, (2) that of flexion with adduction and inversion without shortening, (3) that of flexion, adduction and inversion with shortening. These clinical phenomena, it will be seen, correspond pretty closely with (1) inflammation without softening of the capsular structures, (2) softening of the latter, but little or no destruction of bone as yet, (3) softening of the capsular structures with loss of bone substance. With this division it would perhaps be easier to speak more distinctly on the question of treatment suitable to the different phases of the affection.

Fig. 78.—Dislocation of Hip from disease. (From a preparation in the Museum of St. George's Hospital.)

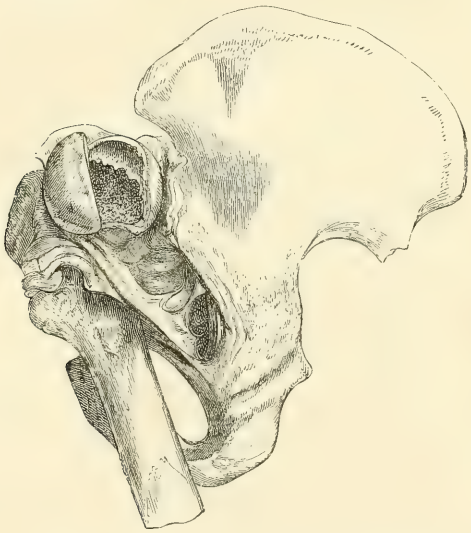


Fig. 79.—The Acetabulum almost filled up with bony deposit after recovery from Hip-disease, in which the head of the femur was dislocated. (From a preparation in the Museum of St. George's Hospital. Series iii. No. 90.)

The *treatment* of these strumous affections of the joints, as far as it is general, has already been considered (p. 343), where we have seen that what is most called for is absolute functional rest for the part, with improvement of the general vitality of the body and local measures to reduce hyperæmia. In the case of the hip, the first of these calls is not difficult to meet, if the patient be confined to the horizontal position. But such confinement would in most cases be injurious, as tending to debilitate the patient and so to lower his vitality. It should not therefore be resorted to except in very early cases, and where a properly constructed couch on wheels would enable the patient to have fresh air and change. Fortunately, we possess means whereby the limb may be completely immobilised, and at the same time the patient be allowed both fresh air and even exercise of the other parts of the body. One of the best of these is the splint and patten, devised by Dr. Thomas. This consists of an iron band covered with leather fixed above to a girdle of similar structure which embraces the thorax, and running down behind the thigh to the lower part of the leg, following the curves of the loin, hip, and knee : it has a half collar above the latter, and at its lower end, to keep it directly in the middle line. The curve at the buttock should be very slight, so that it lies well into the depression between the great trochanter and the *tuber ischii*. Lying thus, it is fixed to the body not only by the girdle with its strap above, but also by a broad flannel bandage at the

waist and another around the limb. If there be any marked flexion of the limb, the back band is bent so as nearly to meet it but not quite. Bound to this the thigh is brought down little by little each day, the iron band being more and more straightened as this takes place, until complete extension is attained. To obviate the inconvenience of holding the limb thus, while walking with crutches, and to prevent all possibility of striking the foot upon the ground and so causing a jar to the diseased joint, an iron patten is screwed on to the sole of the boot on the sound side. Upon this and his crutches the patient now walks, if old enough, the affected limb being raised clear of the ground. In all the stages of disease, except that of dislocation, this splint is invaluable if carefully applied. But if not accurately fitted and adjusted, it is very prone to slip round to the outer aspect of the thigh, where it is of no use. It is also rather difficult to correct any ad- or abduction with it. Its great advantage lies in its giving complete rest to the limb, while allowing of regular exercise of the whole body; it also allows of free access to the joint for any local remedies which may be applied.

Plaster of Paris and starch bandages may also be used to immobilise the limb, but are not as a rule considered desirable appliances, preventing as they do completely all access to the joint, and being very difficult to keep clean. If it be considered desirable, however, to reduce the deformity of flexion, &c., under chloroform, plaster of Paris will retain the limb in a straight position, very completely and comfortably, if applied over cotton-wool.

Sayre's splint, by the use of which he proposed to transfer the weight of the body directly to the knee through a steel rod fastened above to a pelvic girdle and below by plaster to the thigh and knee, is not in use now-a-days in this country or on the Continent. Practically, it does not effect its purpose for long. Another appliance strongly recommended by this surgeon, for young patients, is a wire-woven cradle for the body, continued into two hollow back splints of the same structure for the lower limb; lying in this, well padded, the child is kept extended with the limbs at perfect rest, and can be carried about securely without damage to the joint. These 'wire breeches,' as he calls them, have the advantage of being able to correct ab- or adduction, and rotation, and of enabling the patient to evacuate the bowels and bladder without difficulty or lack of cleanliness.

In those cases where there is acute pain with much deformity and constitutional irritation when the patient is first seen, it is best to leave him in bed. He can be soonest placed in a condition of rest, the pain can be relieved by anodynes, leeching, or warm fomentations, and the deformity overcome either by immediate straightening under chloroform (a questionable practice), or more slowly and safely by extension, with a weight, as already described (p. 365). If there be much tension in the joint, the general symptoms will be much relieved by either aspiration or free incision, as already described (p. 335). The former, performed with every precaution against septic inoculation, will often suffice to tide over a critical point in the disease, and give the distended capsule rest. As soon then as the patient is easy, and the limb fairly straight, a Thomas's splint can be applied, and he can be allowed to leave his bed and to take exercise in the open air. But where incision has been practised, it will be necessary to confine the patient to bed. Here the weight extension will still be found the most suitable for keeping the limb in good position. If it should tend to in or evert to any extreme degree, sand-bags at either side of the knee will usually suffice to counteract the tendency. In some few cases this is not so, and adduction of the limb may be a troublesome feature. Here a long splint bracketted opposite the wound, running from the axilla to below the sole of the foot, will best maintain the straight position and rest.

As to the next two factors in the treatment of strumous hip disease, *i.e.* improvement of the general vitality of the body and reduction of the local hyperæmia and effusion, little remains to be added to p. 343, except to notice that this joint is so thickly covered with soft parts that external remedies act less effectively on it than on others. At the same time there can be no doubt that repeated blistering over the front and back of the articulation is of real use in the earliest stages of the disease

and should be tried in all cases. Again, here if anywhere, the intra-synovial or even intra-osseal injection of solution of carbolic acid ought to be of use, and might be employed (see p. 343).

By one or more of these methods combined the inflammation in the joint may be brought to a standstill in one or other of its stages. Thus hyperæmia may be checked at the outset, and a complete *restitutio ad integrum* result. Or if a little plastic material have been effused into or about the articulation, the process may go no farther, nothing but some slight adhesions being the result. In such a case, as soon as we have reason to believe that all hyperæmia has disappeared, passive motion, with or without an anæsthetic, will restore the normal functions of the joint without further trouble. In beginning passive motion a little difficulty is sometimes experienced in fixing the pelvis which moves with the femur in all directions as it is moved about. This may be best obviated by placing the patient upon a hard surface, and then directing an assistant to hold the sound thigh firmly down in the position of complete extension. This will fix the pelvis, and prevent it from following the affected thigh, when it is now flexed on the patient's abdomen. Circumduction may now be effected without much difficulty. Other means of fixing the pelvis will usually be found inadequate in such cases; fortunately this method meets all our requirements.

Where anything more than slight adhesions exist in the hip-joint the greatest caution should be exercised in attempting to restore its functions by passive motion. The enormous leverage we possess through the length of the femur should be remembered in the first place, and then the ease with which the neck of the femur could be broken through at the epiphysary line in a young subject, especially if it had been recently inflamed, supposing the head were fixed to the acetabulum. It should be remembered, too, that to start the disease afresh in a very bad form is a heavy price to pay for an attempt to restore an amount of movement to the joint, which would not, in some cases, be missed, owing to the free compensatory movements of the pelvis which soon become developed in these cases.

After passive movement has been pushed to the extent of tearing through adhesions, it is well to fix the joint and to apply local antiphlogistics for a few days. There is not unfrequently a little reaction calling for these measures, which, however, are usually sufficient in well-chosen cases to allay all dangerous hyperæmia. In those unfortunate cases where want of judgment has led to forcible movements of joints, from which active disease has not yet disappeared (such cases are seen in the practice of the so-called 'bone setters'), or where union was too complete to admit of any safe restoration of mobility, and where, consequently, active disease has again been lighted up, the same rules of treatment apply as though the disease were primary.

We turn now to those cases where either our treatment has been ineffectual in checking the march of the primary disease towards destruction of the joint surfaces with loss of bone, or where the patient has been brought to us in that state, or, finally, where destructive disease has been rekindled. Here one of two ends must be kept in view, (1) either by providing a free escape for all the products of the destructive process as they are shed off to bring about a healthy reaction in the joint, or (2) by at once removing the diseased structures, in and about the latter, by excision, to leave it in a condition to heal at once. The ultimate result aimed at in both cases is the same —namely, the union of the two bones of the joint by sound tissue, fibrous or bony, *i.e.* fibrous or osseous anchylosis (see p. 359). For the consideration as to which is the best direction in which to work, the reader is referred to the essay on Excision. Here it is only necessary to say a few words as to these two modes of repair after strumous disease and their consequences as regards this joint.

When the morbid process has resulted in destruction of the articular surfaces of the bones of the latter, the carious head of the femur lies in contact with the acetabulum, probably in a similar condition. Now, if they be kept thus in a state of rest, the fluid thoroughly drained off and the patient restored to good general health, the two bones may unite just as a compound fracture does; that is, granulations spring from both inflamed and softened surfaces, coalesce and organise either into fibrous tissue or bone

(p. 359). If, on the other hand, the health remain bad, or the part be not kept at rest, or the pus be only imperfectly drained off and allowed to become foul, the inflammatory process extends deeper and deeper into the bone, more rapidly even than the actual disintegrating change, and the morbid condition is indefinitely prolonged. In this way the whole head, neck, and acetabulum may be destroyed. Should the patient survive this very exhausting process, which so often brings with it the well-known amyloid changes in the internal viscera, repair may however still result through fibrous or bony tissue. In what state of usefulness the limb is now left depends upon the treatment adopted throughout as to deformity. If it have been kept straight or nearly so by weight or splint, the patient will have an excellent limb to walk upon, and especially if the union be fibrous, as is sometimes the case; for then flexion and extension may be possible to small extent, rotation and abduction rarely. And though there be considerable shortening, it is made up for by a droop of the pelvis on that side. With osseous union a perfectly straight bone is not so desirable, the patient being unable to sit down comfortably with it, and the gait being very stiff. Union with slight flexion is better in this case, the foot being thus brought into better position for compensating for the loss of length by pointing of the toe, and the gait is more easy and the step elastic. The patient can also sit down better.

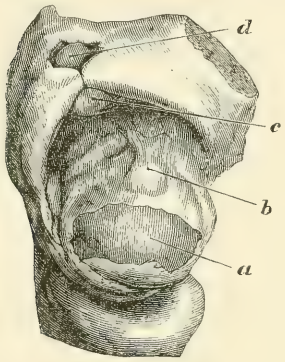
But in cases left quite to themselves, or neglected as regards position while anchylosis is taking place, the results are most deplorable, whether the union be fibrous or bony, but especially with the latter. Here the marked flexion of the thigh, combined with its shortening, prevents the foot from being placed upon the ground, besides which the extreme adduction brings the limb across its fellow to a great extent, perhaps even more than can be compensated for by tilting of the pelvis. Again, the genitals are sometimes interfered with, causing in the female trouble in micturition, and preventing procreation. Not infrequently, owing to one or more of these discomforts, an operation is called for if the anchylosis be osseous. If fibrous, prolonged simple extension will often effect much, even in extreme cases, or this may be aided by subcutaneous section of the fibrous bands with a tenotome. If these means fail, or if the union be osseous, nothing is left but to divide the bone below the point at which it is fixed.

This operation has been especially brought into notice in this country by Mr. W. Adams, and has been frequently practised. The occasions for its use, however, it is to be hoped, will become more and more limited with each year as the necessity of keeping the limb in a favourable position during the process of consolidation is more fully recognised, and the methods of accomplishing it more generally understood. The procedure is a simple one, all things considered, and safe in these days of antiseptic surgery. It consists in making a short incision down to the bone at the point to be divided, and in cutting through the latter either with a narrow lock-saw, as preferred by Mr. Adams, or a chisel, now perhaps more generally used. The point of the bone selected for division varies in different cases. Where but slight destruction has taken place and repair has quickly followed, the neck may be, and is usually chosen. But where head and neck have both been destroyed, a spot about two inches below the top of the trochanter major is selected. In the first case the incision is made behind and above the neck, in the last on the outer aspect of the femur. The choice between the saw and chisel will probably remain a matter of individual opinion for a long time to come. In a considerable number of osteotomies of the femur, the author has always found the tool known in London as Maunder's chisel most satisfactory, and gives it the decided preference over the saw. When inserted as far as the femur, a number of smart raps are given to it with a light mallet, which drives it into the bone. It must be loosened at intervals by a rocking motion, and though withdrawn from the bone if necessary, it need not be withdrawn from the soft parts, which should be kept closed around it by pressure of a soft carbolised sponge. The saw requires a more extensive division of the soft parts, and besides lacerating the latter somewhat, leaves a good deal of bony débris behind in the soft tissues. On one point, however, all surgeons are agreed—namely, the need of the most absolute

cleanliness during and after the operation, and the use of either the Listerian or other antiseptics.

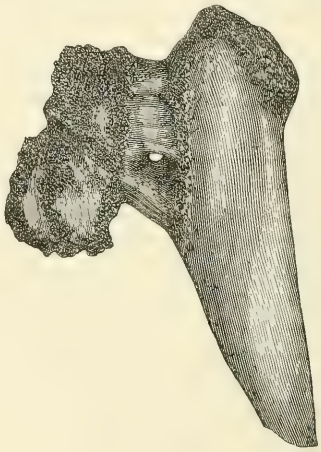
A few words now remain to be said regarding the effects of that form of hip disease in which the acetabulum is extensively involved. The process by which this structure is destroyed has been already described (p. 371). It has been there shown that an abscess is not infrequently produced by it on the pelvic aspect of the acetabulum. This will now either discharge through the latter into the joint, or will run forwards over the ramus of the pubes to point on the front of the thigh, where it may be mistaken for psoas abscess, or it may run downwards to the sciatic notch, and then outwards to the back of the buttock. But before the pus has been evacuated in either of these situations, it has usually done considerable damage to one or other part of the *os innominatum*. Thus by maceration of the bone and periosteum it may give rise to necrosis, varying from small fragments at the base of the acetabular cavity (fig. 80) to almost the whole pubic bone or ischium, which may lie loose in great part in the abscess. Cases are on record in which these bones have been removed in opera-

FIG. 80.—Necrosis of the Acetabulum. (From a preparation in the Museum of St. George's Hospital.)



a, head of femur, extensively exposed by abscess in the joint; *b*, tissue containing the remains of the ligamentum teres; *c*, loose necrosed portion of the acetabulum; *d*, perforation of the acetabulum corresponding to the necrosed portion.

FIG. 81.—Head and Upper Part of the Shaft of the Femur affected with chronic Osteo-arthritis. (From a preparation in the Museum of St. George's Hospital.)



tions for excision of the hip (Erichsen, 'Science and Art of Surgery'). It may, however, be fairly hoped that such cases with this very severe degree of necrosis will become rarer and rarer, until they are never met; the benefits of free drainage and early excision being now each day more fully recognised. No special directions can be given for dealing with sequestra about the acetabulum when present; they must be treated upon the principles which guide us elsewhere, the great aim being to remove them as early as possible, and to provide free drainage for the cavity left behind.

Gout, in the ordinary sense of the term, is not one of the common affections of the hip-joint. If met with here, it presents no special features, and requires no special treatment which need be described here.

What is known, however, as rheumatic gout, or *arthritis deformans*, has one of its favourite seats in the hip-joint. The nature of this disease has already been discussed (p. 344 *et seq.*) and it only remains for us to consider how it affects this particular articulation.

We find here, in the earlier stages, the same pearly thickening as elsewhere of the borders of the articular cartilages, both of the femur and acetabulum. In some cases at this time we find, too, distinct evidences of irritation in the form of congestion of the synovial fringes. This may even be sufficient to cause marked hyperplasia in the latter, amounting, I have seen, to the production of pendulous fibrous

bodies attached to their borders.[1] It may even go farther, leading to effusion in greater or less amount. But the inflammation in these cases is not acute, and is accompanied by but few subjective symptoms. But it is the secondary changes of this low inflammatory process as they affect this joint that offer matter for consideration. As a rule, we have here a plastic osteitis of so low a type that, while, on the one hand, it may soften the bone of the joint surfaces sufficiently to admit of their being moulded and altered in shape by the forces acting upon them, it may on the other hand produce new bone very slowly at those points of most irritation—namely, where pressure and friction are greatest. The consequence of this is that deformity is produced by the forces acting on the softened bone, while only a very imperfect attempt at repair is made. Thus we find in many cases the posterior and upper part of the acetabulum softened to such a degree that it has been unable to support the pressure of the head of the femur, and the latter has gradually moulded and pushed the material of the brim upwards, until it has come actually to lie above and behind the acetabulum in a kind of rudimentary socket, giving an example of 'dislocation by deformation' of Volkmann (conf., dislocations by 'distension,' p. 366, and 'destruction,' p. 371). This socket, however, is very imperfectly formed by a mass of spongy bone at first, which may eventually become sclerosed, and, in that case, even eburnated, until tolerably free movement is possible. The head during this time is also altered in shape variously, having usually large masses of new bone thrown out around its border beyond the limit at which it comes in contact with the acetabulum (fig. 81); this is at first spongy, but may eventually become hard and likewise eburnated. Again, the softening process may lead to the complete wearing away of the head of the femur, until the root of its neck alone plays against the other bone.

In other cases, however, the course of things is different; the head may press deeper and deeper into the soft acetabulum, while around the borders of the latter new bone is thrown out, deepening the cavity very materially. In this way the head may eventually be almost surrounded by bone, and its movements greatly restricted, or even in extreme cases completely prevented. This locking of the bones together by 'deformation' is rarely or ever accompanied by true synostosis, or fusion of the two surfaces together, such as takes place in anchylosis after destructive disease.

Sometimes these changes are accompanied by very marked and increasing adduction of the thighs, as though either the necessity for relief of the tense anterior capsular structures now irritated existed in these cases also, as already described for the counter affection (p. 369), or the enlargement of the head was actually thrusting it away from the acetabulum, and so levering the femur into the adducted position against the fulcrum of the Y-ligament, now too short for such an altered condition. This adduction sometimes brings the knees firmly together, and the patient is prevented from walking except from the knee-joint; in other cases the limbs cross one in front of the other, and produce a very peculiar condition of progression, the knee alone being moved. This has been specially described under the provisional name of 'cross-legged progression' by Mr. Lucas,[2] who suggested various explanations of the condition. His paper, based upon two cases, not both arthritis deformans, was followed by the record of another case by Mr. Tyson,[3] in which this disease was most probably the origin of the deformity.

As to the treatment of *arthritis deformans* in the hip, little need be added to what has been said already (p. 347). Once the disease has begun here, it tends in the majority of cases to grow steadily worse, taking one or other of the directions alluded to. The only local treatment likely to be of any avail is the use of systematic friction with liniments of a stimulating kind. In so far as these promote an active circulation in the part and increased vitality, they are of use, but only so far. Flannel coverings act in the same way, and should always be worn over the joint. In those rare cases where breaking down of the soft and hard tissues of the joint occur, and slow suppuration is the result, the question arises, What should be done? should the parts be

[1] *Trans. Path. Soc.* vol. xxx. p. 353.
[2] *Trans. Clin. Soc.* 1881, p. 20.
[3] *Ibid.* p. 186.

excised, or simple incision trusted to? At present the answer would be decidedly in favour of the latter proceeding. If, as appears probable, the morbid process is the result of the lowering of vitality in the tissues with degeneration, the prospect of repair after so severe an operation would be very remote. And, indeed, even incision should be delayed as long as possible in the hope that the fluid matter in the joint may be re-absorbed. Most surgeons must be familiar with cases where a doughy swelling has formed at one spot over such a joint, with dusky redness and softness, where they have been satisfied that a breaking-down process and formation of fluid was taking place in this disease, and where, nevertheless, with rest, local and general treatment, the symptoms have disappeared and recovery with anchylosis has taken place. If, however, such a collection is about to burst, we have nothing left but a free incision, with scraping out of any morbid matter within reach; the whole operation to be conducted on the same principles which guide us elsewhere.

Loose bodies are not unknown in the hip-joint, though very rare, as already stated (p. 355), and their mode of formation has been indicated.[1] Owing to the structure of the joint, they appear, so far as is known, not to give rise to symptoms, or to call for treatment. I have not been able to find any case in which an operation was undertaken for the condition.

Mimic disease is not infrequent in the hip, and may give rise to errors of treatment, unless the surgeon is on his guard. A careful study of the characteristic positions of the limb in the various stages of the true disease will be our best guide here. The intense pain complained of will probably be entirely out of keeping with the absence of change of position as described, which ought to be very great if the disease were commensurate with the suffering complained of. Again, the fact that the pain will be generally referred to the hip itself, instead of the knee, in mimic disease will help us in reference to this particular joint. The general conditions, however, already noticed at p. 360 are the most important of all for coming to a correct diagnosis in any given case.

Affections of the Knee.

The knee, as second in importance to the hip, must next be examined.

Perhaps of all the joints of the body this is the most frequent seat of *simple acute synovitis*. Its exposed position both to injury and vicissitudes of weather, together with its functional activity, will account for this.

The subjective symptoms here are those enumerated as present in all attacks of this form of disease in any other part (p. 334), and nothing special need be added. The objective symptoms, too, require little particular notice. Here, however, the swelling will be particularly well marked and also the fluctuation, the part being so superficial. These are most notable at either side of the patella below and above it, for the reason that at these spots the coverings of the joint are thin. The patella in the straight position of the limb will be lifted off the articular surface of the femur and float, so to speak, on the synovium, but can be pressed down upon the femur with a little force. The knee, if left to itself, will now assume a more or less flexed position. The explanation of this is simple, and in harmony with what has been seen to hold good in the case of the hip. The fact is, that in the extended position of the limb, the parts of the capsule most on the stretch are the posterior structures, with the external crucial ligament. As soon then as inflammatory irritation commences within the joint, the patient instinctively relaxes these by flexion for their relief, the thin looser structures in front needing no relaxation. Attempts now to straighten the knee will be resisted, lest the tension behind should be increased. Further flexion, too, is opposed, so that the inflamed surfaces may not be swept one over the other.

Such, then, would be a case of simple acute synovitis coming on, for instance, after some injury, such as a blow or strain. It is not likely to be confounded with any other condition, unless possibly an effusion of blood into the joint, as is not

[1] Barker, *Trans. Path. Soc.* 1878, p. 353.

infrequently met with after violence, but a little care will prevent any mistake. In hæmarthrus the swelling sets in usually a little earlier than we would expect acute inflammation. Thus, within an hour or two of the receipt of the injury, the patient will find his knee distended with fluid and stiff. Then, he will complain of little or no real pain, though he may say perhaps that the part feels slightly 'sore.' There is no tenderness or heat about the latter, and though the skin may appear a little reddened possibly, it is not from increased vascularity, but from that imbibition of the colouring matter of the blood, which takes place so soon in most cases where blood is effused subcutaneously. If seen somewhat later, this colour may be a little mottled, with a suspicion of purple, or even green, as after ecchymoses. Again, the limb is not flexed in this case, and movement is not painful, although limited by the distension of the capsule. Finally, puncture of the latter with a fine, thoroughly cleansed needle will give exit to the blood and settle the diagnosis.

The general treatment of synovitis of the knee will be conducted upon the lines laid down already (p. 335). In addition here, the joint must be placed in the position of greatest rest, and so immobilised. This is best done by leaving the knee slightly flexed, and fixing it thus upon a Macintyre's splint. This apparatus is well suited to such cases, securing perfect rest for knee and foot, while giving free access to the part for the application of local antiphlogistics. But, if it is not to hand, a straight back splint, with a thick pad for support in the popliteal space, will answer very well, or a scored Gooch's splint. This fixation, combined with the local treatment indicated on p. 335, will usually suffice to check the inflammation and restore the functions of the joint rapidly. But, if the attack have been severe, and have lasted longer than is the rule, troublesome complications are not infrequently left behind. In the first place, there may be much stiffness of the joint, due to plastic matter effused in and about the capsular structures, and more or less organised, perhaps a little also between the ends of the bones uniting them, but not firmly (see Anchylosis, p. 358). When this state of things exists, after all trace of inflammation has disappeared, it may be remedied in some cases by easy passive motion without an anæsthetic, or, if this fails, as it sometimes will, by forcible flexion and extension with the latter. In this way the adhesions are either gradually or immediately stretched and torn, with a distinct crackly or rending sound, and sometimes, where much adhesion has existed, with a little effusion of blood into the joint. After this measure, it is generally desirable to fix the joint again for a day or two, and to reapply the local antiphlogistics, lest inflammation be excited once more. This is not to be feared if the patient be healthy; but otherwise there is considerable risk, if we have resorted to the forcible flexion too early.

Another change to be feared after these attacks of acute synovitis is that they may, either from neglect, want of energetic treatment, or constitutional fault, run on into the *subacute* or *chronic* forms of the disease. These hardly need any long description here, offering few special features in the knee not already considered (p. 336). It must be mentioned, however, that after the subacute affection, that condition already spoken of as hydrops articuli (p. 336) is oftener left behind in this than in any other joint. Thus the whole knee may, in extreme cases, look like a bag of fluid, the capsular structures not being even very tense, although many ounces of fluid may be contained in it. But the only trouble complained of by the patient is a sense of weakness in the part. Subjective symptoms are absent; the objective are only an exaggeration of those already seen in the acute form, but without the flexion probably.

As to the treatment of this condition, it is not difficult in most cases. Rest in bed, with repeated blistering or painting with Tr. iodi, and a few brisk saline purges, will often suffice to remove the fluid. But the latter in many cases returns more or less when the patient begins to walk again, unless precautions are taken; these should consist in very careful strapping of the whole knee with adhesive plaster, commencing about a hand's breadth below the patella and carried upwards (each strip well overlapping the one next below it) to the same distance above it. This covering of plaster should be covered by a bandage, evenly and firmly applied from the foot upwards.

A thin well-fitting covering of plaster of Paris, or starch bandage, is also of much use in these cases. These coverings should be worn for a considerable time, and should be replaced as they wear by similar ones, or an elastic web knee-cap, as long as there is the slightest tendency to refilling of the joint. When all tendency to this has ceased, and the fluid has nearly or quite disappeared, it is well to employ cold douches with shampooing, with stimulating liniments, for some time, to encourage a healthy vascularity in the part. If all these means fail to remove the fluid, it should be aspirated one or more times with all precautions as to antisepsis, the limb being strapped as above after each operation. If even now it refill, it is well, after emptying it by aspiration, to inject into the joint a small amount of some slightly stimulant, but perfectly antiseptic, fluid, such as carbolic solution of the strength of $2\frac{1}{2}$ per cent., or of iodine and water in the proportion of ʒj to ʒij to the ℥j. This, if carefully managed, excites a decided reaction in the joint, with some swelling and heat, which after a few days subside, and usually leave the part free of the tendency to fill up as before.

It is very desirable to treat these cases of hydrarthrosis early, before great distension has taken place. When neglected, the joint is very much weakened and is slow to recover even with the most suitable treatment.

In the *chronic simple form* of synovitis, this fluid effusion may also be associated with a good deal of thickening of the capsular structures, which may be converted by hyperplasia into soft pulpy tissue. But this produces a condition as to symptoms and treatment so similar to strumous synovitis, now to be considered, from which it probably only differs in ætiology, that one description will suffice practically for both.

The three forms of *septic synovitis*—the acute, sub-acute, and chronic—which we have already considered elsewhere (334), present no peculiar features as developed in the knee, and need not therefore be separately described. It is enough here to say that the acute form requires the earliest and most energetic treatment, if we are to save the joint at all. Aspiration is here rarely sufficient, and it is better, as soon as we can prove the existence of suppuration, to lay the joint open on both sides by free incision, and wash it out with carbolic lotion, then putting it up under an antiseptic dressing, with careful drainage and immobilisation. The incisions here, as above, should lie well back, so as to thoroughly drain the deepest part of the cavity. As to the sub-acute and chronic forms of the disease, if distension be great, aspiration repeated over and over again may be sufficient; but here, too, incision should not be too long deferred. In many cases, however, local antiphlogistics (p. 335) will be adequate for the local condition. The general treatment of the constitutional state has been already considered (p. 335).

Strumous disease of the synovial membrane of the knee differs in no respect as to ætiology and pathology from that met with in the same structures elsewhere (see p. 342). We have only then to consider here the subjective and objective symptoms due to the disease in this particular situation.

Very often in the early stages of the disease, the subjective phenomena are almost nil. There is little or no pain, heat, or throbbing. And yet objectively we have suspicious features about the case. Thus a slight fulness may be noticed above and below the patella on either side. This is due, not to the presence of fluid in the joint, but to thickening of the actual synovial tissues, in which those low plastic changes are taking place already described. There is consequently no fluctuation here, but a doughy or elastic sensation to the finger under palpation. Again the limb will usually be slightly flexed, for reasons already given in speaking of acute synovitis (p. 378), though to a minor degree. The whole joint, too, will look more bulky generally, but at first there will be no alteration either in the colour or lustre of the skin. Passive movement or walking will produce little discomfort, though some sensation of stiffness may be complained of.

Later on, however, when the ligamentous structures are being invaded by the inflammation, and are becoming softened and weakened, the symptoms will be very plain. Besides the exaggeration of the fulness already noticed, there will be greater flexion with pain on movement of the joint surfaces one over the other, although

perhaps little or none on simply resting the weight of the body on the bones without movement. The local heat will also be increased, and there will probably be a slight general rise of the temperature of the body. Tenderness will also be marked, usually most so at one or other side of the patella. In those cases where caseation or actual purulent softening is taking place, at one spot or other of the synovial or capsular structures, the colour of the skin will be deepened more or less by congestion, and the heat will be raised. But, even short of this, the skin over the swollen joint will be altered in appearance. It may be paler than usual, with a peculiar glazed lustre, and may be marked by many veins, which stand out in relief as blue lines against the general white tone of colour. As the condition advances to an extreme degree, all the symptoms become aggravated, and in addition we have another notable change, if the limb be left to itself—namely, actual displacement of the bones from their normal relations to one another. Thus we find besides the flexion, now extreme, that the tibia is actually drawn backwards on the lower end of the femur, which now projects in front with the patella; at the same time the tibia and fibula together are rotated more or less outwards, and as the patella follows, it now rests more or less upon the outer condyle of the femur. Fig. 82 represents this displacement in an extreme degree; its cause is not far to seek. It will be remembered that in this stage the ligamentous and capsular structures have become softened by the spreading to them of the low inflammation which commenced in the synovial membrane. In the flexed position of the limb, then, there is nothing to antagonise the strong action of the flexors in the ham, which in this position tend to draw the head of the tibia directly backwards, and as the ligamentous structures are soft, they gradually yield to the strain. Again, as the external hamstring muscles act at a greater distance from the axis of the tibia than the internal, they possess more power of rotation of the bone than the latter, and as the ligaments yield, the head of the fibula is drawn backwards faster than the inner border of the tibia, the result being rotation outwards of the leg and carrying outwards of the patella.

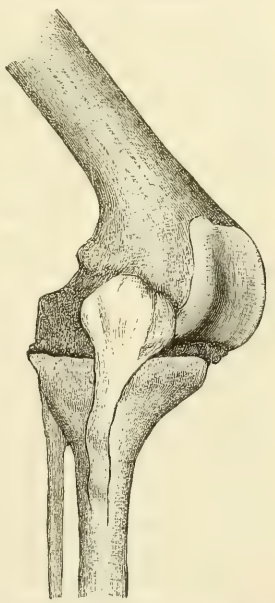


Fig. 82 shows the characteristic position assumed by the Knee-joint when left to itself in advanced Strumous Disease of the Synovial Membrane, viz. flexion, rotation of the tibia outwards, its partial dislocation backwards, dislocation of the patella outwards. (From a preparation in the Museum of University College.)

As to strumous disease in its relations to the ligamentous and cartilaginous components of the joint, it may be stated never to arise in these primarily. As to the first, we have already seen that they are eventually involved in the slowly advancing change of the synovial structures, and are fused with them into a soft spongy granulation material. As to the second, it is sooner or later affected in a secondary way by those changes already described (p. 349). Thus the hypertrophied synovial fringes swelling in all directions will travel across the surfaces of the joint, until between the two bones there lies a layer of granulation-tissue. Whenever this touches cartilage, it will produce eventually proliferation of its cells and ulceration. This may go on to partial or complete destruction of the articular covering. But this disease never commences primarily in the cartilage.

Turning now to strumous disease of the knee commencing in the bone ends, it may be stated at once that the startin-gpoint here is usually an epiphysitis (see p. 353) either of the femur or tibia. This, resulting in an osteomyelitis granulosa, gradually sends up through the end of the bone into the joint processes of inflamed medulla, which bore through the encrusting cartilage as already described. In the joint they produce the same gradual destruction of the cartilage as the spongy inflamed synovial

membrane has been seen to do. And, not only this, but the inflammatory action may spread to the latter, and produce in it the same changes as those resulting from primary disease of its own structures, already considered. In such a case as this we have all the structures of the joint diseased, and shall probably be unable to distinguish in any particular instance which is most so. On the other hand, we not unfrequently meet with instances of strumous disease in the bones of the knee-joint in young children, which does not affect the articulation at all primarily, and may be prevented from doing so secondarily if diagnosed early and judiciously treated. This strumous epiphysitis, namely, has tended to spread rather along the plane of growing tissue at the end of the diaphysis, and to present at the periphery, under the periosteum, outside the synovial cavity of the articulation proper; unlike the hip and shoulder, where the epiphysary lines lie inside the capsule.

It may be well now to consider for a moment some points of diagnosis between the different forms of the affection when seen early.

If the synovial membrane be alone the seat of the change, the knee will be but very little swollen, and some of the swelling will be due to slight effusion into the joint, which may be now felt to fluctuate. But there will be a little pulpiness about the thinner parts of the capsule not present in ordinary synovitis, and yet not sufficient to indicate that the change has reached the capsular structures. The latter, too, not being inflamed, there will be little pain on movement, and not much instinctive desire to flex the part. The outlines of the bones are unaffected, and resting the weight of the body on them is not accompanied by pain.

If, on the other hand, the capsular and ligamentous structures be involved in the pulpy change, the swelling and roundness of the knee will be well marked with a doughiness of the most prominent parts, which will mask any little fluctuation which may be present. The subjective symptoms will be more marked also; but besides this, flexions will be present, as also pain on any movement which stretches the ligaments. As yet there is none of that starting of the limb already described as frequently present when the cartilage is becoming eroded. Nor are the outlines of the bones in the least masked at present.

When, on the other hand, the disease starts in the ends of the bones, pain and limping are some of the earliest symptoms. These may be present before any flexion is noticeable. The weight of the body is early felt on the tender ends, and the position of flexion will be assumed at last, in order that the surfaces may not be kept firmly pressed against each other by the action of the ligaments in the extended position. But when the patient is lying down, the part may be freely moved backwards and forwards if it be not too firmly extended, the rubbing of the still healthy joint surfaces producing no discomfort. Then there will probably be a good deal of gnawing pain in the ends of the bones, especially at night. The latter, too, will be more or less expanded, and may be felt altered in outline to a slight extent; they will also be tender just above and below the joint surfaces when pressed upon from the sides. In those cases, too, where the disease in the bones is spreading along epiphysal planes, we shall find in addition to these symptoms other more distinct evidence developing later on. Thus we may find one spot on the external or internal surfaces of the condyloid portion of the femur becoming tender and swollen over a limited area: later this may acquire a dull red colour, and give a doughy or fluctuating sensation to the finger on palpation; then this collection may burst externally through the skin and externally also to the synovial cavity of the articulation, and our probe may be passed to a greater or less depth into the bone, but not into the latter, unless in advanced cases. The same evidence may also be forthcoming that the head of the tibia is diseased alone and independently of the joint surfaces, the external abscess pointing through the skin in this case about half an inch or an inch below the articular surface of the bone.

But when the disease in any of these situations becomes advanced, it is almost impossible to diagnose in which it has originated, or indeed in which of them it is most advanced in many cases.

Turning now to the treatment of strumous disease of the knee, the synovial and bone

varieties may be taken together, what is suitable for one being equally so for the other up to a certain point. The general constitutional treatment of struma has already been alluded to, as far as necessary (p. 343), as also the local antiphlogistic management. It is only necessary, then, here to point out how the latter can best be applied to the local condition of this particular joint.

In the first place, rest has to be secured for the knee without interfering with due exercise of the rest of the body. In very early cases, and with intelligent children, it will be enough to immobilise the joint with a padded back splint of leather or wood, and allow them to go about on crutches in the open air, the knee being treated locally with blistering, painting with tincture of iodine, or scoring with the actual cautery. But with many young people the desire to use the limb will be too strong for them, whether they are on crutches or not. Under these circumstances nothing can be better than Dr. Thomas's splint, which will prevent this and at the same time enable the patient to have a fair amount of exercise, eventually without crutches. This appliance consists of a strong circlet of iron covered with leather, which embraces the thigh on the affected side, so that a padded portion of its circumference may rest against the under surface of the *tuber ischii*. From this collar two strong iron rods run down at either side of the limb to about two or three inches below the sole of the foot, where they both terminate in a ring of iron, flat towards the sole. To this ring the foot should be fastened with strips of plaster, making extension in the usual way. The vertical rods, running now at either side of the knee, are fixed to the latter either by turns of bandage or, better still, by a broad leather sheath stitched to the rod at either side, so as to support the back of the knee, combined with circular bandaging. With this splint applied the patient rests, when in the upright position, with his *tuber ischii* seated upon the iron circlet above, and the whole weight of the body, on this side, thrown upon it, and through it to the side rods and foot-piece, the foot itself being prevented from reaching the ground. With an iron patten screwed on to the sole of his boot on the sound side, he is now able to walk about (at first with crutches) very fairly, the knee being at perfect rest and undergoing any local treatment all the time. After a while, when the power of balance is acquired, the crutches are put aside and the patient can walk well, though of course stiffly.

This splint is suitable for every stage of the disease, wherever it commences. It is one which can be easily made and readily applied or removed. With it any tendency to flexion of the knee can be combated in the earlier stages by extension to the foot-piece. Even later, where flexion has been neglected and has become extreme, the limb may be brought down straight by a combination of extension with pressure and counter-pressure on the knee forwards and backwards, by means of leather sheets passing across above the joint, in front of the lower end of the femur, and below, behind the calf. The extension may be made a continuous and elastic one by the insertion of an elastic ring between the foot-piece and the extending straps of plaster. Broad straps of india-rubber may also be used above and below the knee, instead of leather, for the same purpose. Other appliances may of course be used for immobilising the knee, such as plaster of Paris or starch bandages; but there is an objection to these, that they prevent the employment of local remedies, and they do not take the weight off the limb. But with Thomas's splint we can treat a case from beginning to end in any stage, from the milder to the worst forms of suppurating joint.

If the actual cautery is considered a desirable counter-irritant in any case, and I know no better, it may be used either in the form of light strokes with a narrow iron on the lateral aspect of the joint, so as to produce rapid blistering, or it may be applied over one large surface, about 1×3 inches, more vigorously with a flat instrument, so as to make an open suppurating surface, as practised by Syne. This may be kept open with Ung. Sabin. all the time the patient is taking exercise on his splint.

But, in spite of all our care, or in the absence of any treatment, such cases of strumous disease of the knee will often run on to the formation of caseous material,

either in the massive granulation-tissue, derived from the synovial and capsular structures, or in the head of the bone. In the former case, however, it does not at all follow that the softening action may open up the joint surfaces. In a very large proportion of cases, caseation having commenced in the peri-synovial tissues, forms an abscess, which may extend widely, and eventually open through the skin without implicating the joint proper at all. The extent to which this is possible is very remarkable, and cannot be too often insisted on, as errors are very apt to arise from overlooking the fact, and a joint or limb may be sacrificed in the belief that the sinuses, leading deeply downwards, actually run into the articulation. I have seen amputation through the thigh performed on the supposition that several sinuses around the knee led into the joint, and that the latter was consequently disorganised, and where subsequent dissection showed that the encrusting cartilages were healthy, and the joint unopened by the suppuration, though the soft parts were freely traversed by sinuses, external to the synovial lining. In this case the knee and limb would apparently have been saved by an opening up of the sinuses and scraping out of the caseous materials from the peri-articular abscesses. Such treatment will often afford just as good results in very young persons, even if the joint should be opened during the operation, as a free excision would. If it be adopted early when the breaking-down process is commencing, a simple incision being made antiseptically into the boggy focus, and all the diseased tissue scraped away with a Volkmann's sharp spoon, the spread of the disease may be prevented, and the resulting cavity will heal rapidly.

The same almost may be said of that form of the disease commencing in the ends of the bones, particularly the tibia. This may advance to a considerable stage of development without actually invading the joint. A knowledge of this, and of the fact that the disease frequently commences in strumous epiphysitis, may lead us in the future to examine this part of the bones much earlier for evidences of morbid action, and when we have found this to operate early upon the condition before it spreads far. Our line of action in such cases is to cut down upon the tender spot over the epiphysary line (with all care to protect our wound from impurities) and then to scrape away with a sharp spoon any diseased tissue that may be found there. The resulting cavity should be kept open with a drain-tube, and allowed to granulate up from the bottom. It should never be forgotten, however, in operating upon this part of a bone, that we are dealing with a very fragile tissue, and that any undue force or roughness in scraping must be carefully avoided, lest we damage the growing tissue around which we are leaving behind. With due care many joints may be saved by this simple operation, but without the gentlest treatment it may do more harm than good.

In those cases where the disease, starting either in the synovial tissues or the ends of the bones, actually spreads to the surfaces of the joints, and causes destructive and increasing change there, either accompanied by suppuration or without it, the question will arise as to whether the joint can be saved by anything short of excision. Leaving the discussion of this point in detail for the essay on Excision of Joints, it may be stated here shortly that the knee in this state can be often saved by free incision with careful drainage. The best incisions to make for effecting the latter purpose are those to the benefits of which attention has been drawn by Mr. Rushton Parker, of Liverpool. These are made at either side of the joint over the condyles, but well behind, so as to drain the back part of the cavity. They should be very free and open up the synovial pouch freely. When made, the limb should be immobilised on a Thomas's or Macintyre's splint, and the joint washed out occasionally with carbolic or tincture of iodine solution, all dressing and treatment being conducted on the best antiseptic principles. This thorough drainage, if it be maintained, is frequently followed by the best results, the cavity gradually filling up with plastic matter, and the wounds then granulating up from the bottom. So long as the free escape for the pus is provided for, the course of cases treated in this way is usually favourable, and if healing take place, it is needless to say that the condition of the limb is more favourable for walking than after excision of the ends of the bones. This free incision at both sides of the joint may be often followed with advantage by free

scraping away of the diseased tissues with sharp spoons, which will much assist nature in getting rid of the products of necrosis, either in the bones or soft parts.

Finally, it may be noted that, if any joint in the body offers greater opportunities than another for testing the value of the intra-synovial and inter-osseal injection of carbolic acid solutions, as recommended by Hueter (p. 343) for strumous disease, it ought to be the knee, all parts of which are so easy to reach with the needle, and are so open to observation after the operation. The method deserves a fair trial.

Syphilitic affections of the knee-joint offer no special features for particular description. It need only be said that they may present themselves in infancy, in youth, and more rarely in mature life. Those met with in infancy are usually the forms of epiphysitis already described (p. 353), due to the hereditary taint. This form is only met with in infancy, and is not difficult to recognise. The first point noticed will probably be a disinclination on the part of the child to move one of the knees. The latter will be kept at rest, while the other is freely moved about. There will be little or no suffering apparently, and no special subjective symptoms. But an inspection of the knee will show that all is not right. At first there will be nothing more than slight swelling without redness over the lower end of the femur and upper end of the tibia. The joint-surfaces will appear intact, and passive movement of one over the other will cause no pain, if gently applied. A little later the swollen spots will be found to fluctuate, and probably now there will be pain, with possibly evidence of separation of one or other epiphysis. This will consist, if the femur alone be diseased, in slight deformity of the knee, the epiphyses being drawn backwards with the upper end of the tibia, and the lower end of the femur projecting forwards more or less. If both bones be diseased, there may be in addition to this some displacement of the tibia also. Besides this, careful lateral movements will often elicit free crepitus between the shafts and the epiphyses, while moderate flexion of the joint-surfaces will not do so. Then there will be complete loss of power in the limb, which will lie as still as if paralysed (Parrot, *vid. sup.*)

The syphilitic affections met with in youth in the knee are merely the expression of the deposit of the usual granulation-tissue in the soft tissues of the joints or the bone ends. When the synovial and capsular structures are alone affected, the joint will not be so evenly swollen as in the strumous affection; it will have a more uneven or lumpy look, though otherwise very much in the same condition as if affected with strumous synovitis. It requires practically the same treatment locally as the strumous form of the disease in its earlier stage of deposit, combined with the usual antisyphilitic remedies. It is a remarkable fact about this condition that it appears to give rise to very little pain or discomfort, even when marked in the synovial structures, the patient being able to walk very well on the affected limb.

The syphilitic affections of adult life, on the other hand, may be either the transient inflammatory affections of the synovial membranes met with in the earliest stages of the acquired affection, already described (p. 341), which are usually accompanied by some effusion, or they may be of the nature of diffused gummatous infiltration of the synovial structures or bones, or actual concrete gummata in one or other part of the joint structures undergoing some of the changes to which these deposits are liable. Lancereaux's[1] conclusions led him to the belief that these neoplasms differed neither in colour, consistence, nor histological composition from syphilitic deposits elsewhere in the subcutaneous tissue or the viscera; also that the knee was the joint most frequently affected with this form of syphilis. This is the joint, too, in which I have mostly seen the disease.

Gout of the knee presents no special features peculiar to the joint, and requires no particular description beyond what will be found at p. 343.

Arthritis deformans (p. 344) is very frequently met with in the knee, and is a source of much trouble to those affected with it, although not so crippling in its effects as when seated in the hip. The pain in the joint is chiefly felt in the morning, and is soon followed by limitation of movement. When examined now with the hand, the out-

[1] 'Des Arthrites Syph.,' *L'Union Méd.* 1873, No. 88.

line of the joint may appear lumpy around the borders of the encrusting cartilage. During flexion and extension, too, a peculiar crackling may be felt by the hand of the surgeon and by the patient, in the earlier stages, due to the rubbing of the uneven cartilaginous surfaces one over the other. Later, the distinct grating of bone against bone can be easily felt. When eburnation has taken place, the movements of the joint may once more be pretty free, the polished surfaces rubbing one over the other with but little friction, but before this has been completed, much cutting and scoring of the apposed bones has taken place. Sometimes, however, the softening process found in the earlier stages of the disease lasts long enough for the tibia to be much altered in shape by the pressure of the femur, which generally suffers less. Thus we may find the latter nearly or actually buried in the former, with much osteophytic deposit around. Unlike the other affections of the knee, already described, there is here but little tendency to flexion as the process advances. The latter is a slow degenerative one, and causes but slight irritation of the capsular structures.

This is one of the joints in which *arthritis deformans* is occasionally accompanied by suppuration, perhaps, indeed, more frequently so than any other. This phase of the complaint is usually met with in younger patients than those we are familiar with as typical subjects of arthritis deformans. Indeed, the question often suggests itself in examining such cases whether we are not perhaps dealing here with a hybrid disease, as it were a mixture of struma and arthritis deformans, or perhaps syphilis and the latter. For, occurring thus in younger individuals, the affection presents many points of resemblance with strumous disease, without forfeiting, however, its primary characters. Again, patients who have developed the softening species of arthritis deformans in its typical form, other joints besides the knee presenting the characteristic nodular enlargements, may recover from the actual suppurative phase of the disease, only to die shortly after of typical tubercular disease, no new ætiological factor having presented itself in the meantime. Of this I have recently had a striking example.

The fact that the knee is the joint most frequently attacked with the suppurative form of *arthritis deformans* is perhaps explained by its exposure to so many external influences. When this change does take place, it is usually an insidious one. The symptoms of its onset are not very well marked, but are sufficiently so to make a diagnosis with tolerable certainty. Superadded to the condition already described, we now find slight heat of the part, with dusky redness, usually at either side of the knee over the head of the tibia. Underneath these there will be a sense of doughiness to the touch, hardly amounting to fluctuation. If the condition advance and further softening take place, true fluctuation may be felt, and the collection of soft material may even gradually work its way to the surface, and discharge there in the form of whitish curdy or cheesy débris. In other cases such a collection may make its way into the soft tissues around the joint, and form a large cold abscess, as I have seen in a very marked case. All this time there may be little or no inflammatory reaction in the knee, and but little pain unless on motion, even in extreme cases, the whole process being little more than a degenerative one. But when an accumulation of this kind has been left to itself to burst, or has been opened without due antiseptic precautions, sooner or later the part is almost sure to become foul, and then we shall find a discharge of true pus, replacing the curdy material, and with this change all the evidences of active inflammation. But such external openings do not always form, and a reparative action may set in under careful local and constitutional treatment in the direction of improving the vitality of the tissues now degenerating. If this be the case, more or less complete anchylosis may take place, which, as already stated, is very exceptional with arthritis deformans; here it is only possible as the result of suppurative destruction of the joint surfaces. But in this last case actual synostosis may take place, unlike the simple mechanical locking of the parts so often seen in the usual form of the affection.

In considering the question of treatment, the first point to be noted is that very much more may be accomplished by improving the general health and vitality of the body than by any local treatment. The best we can do in the latter direction is to

guard the knee from cold and damp, by covering it with cotton-wool or flannel, and to employ systematic friction, with or without stimulating liniments. In the earlier stages the part should not be immobilised, and the patient may be encouraged to take exercise, so as to encourage active circulation. Later on, when the ends of the bone are in a softened condition, if there be any tendency to deformity, the knee may be supported by a splint of leather or wood, and exercise need not be interdicted if the patient can bear it. But when actual liquefaction is taking place, the most complete immobilisation is desirable. This is perhaps best compassed by the plaster of Paris bandage applied over cotton-wool, though the starch bandage also is suitable and lighter. But whatever is applied should be portable by the patient himself, and enable him to take exercise on crutches, which is essential if the part is ever to be repaired. In those rare cases where the disease advances to liquefaction on a large scale, and the joint ends are bathed in broken-down material, the question arises whether incision and drainage, or complete excision, is the most suitable treatment. Premising that no cutting operation is desirable in such cases, unless as a last resource, and where the collection is about inevitably to burst, it may be said that probably both procedures have their place. But, considering the age at which this disease usually becomes extreme, and the general lack of vital force of which it appears in many cases to be merely the expression, we cannot hope for much from either, the prospect of repair being so slender. Nevertheless cases are met with from time to time in which there appears to be nothing left but one or other, the joint being completely disorganised. In some of these, especially where the bones are less involved, free incision and drainage will do all that can be done for the joint; in others, where there is already much destruction of bone, it may possibly save some time if the joint be freely opened and the ends sawn off. But up to the present, excision has not been looked upon with favour for this disease, and has been very rarely practised. Mr. Gant[1] has recorded a case, however, where he excised the knee of a woman past middle life, for an affection which he regarded as probably arthritis deformans, and with a favourable result. Mr. Curling[2] had already placed a similar case on record in 1869, which is alluded to by Mr. Gant. Mr. Holmes, too, has told me of another case, in which this operation appeared to hold out the best prospect to one of his patients suffering plainly from this disease, and where the event justified his conclusion. It seems likely, however, that in the future, incision, with free scraping of the diseased surfaces with a sharp spoon, will take the place of formal excision, and save any cases which are to be saved from amputation, which is all that is left if repair of the bones does not take place.

Sometimes arthritis deformans gives rise to the production of outgrowths either from the synovial membrane, cartilage, or bone, which form pedunculated masses liable to be broken off, forming *loose bodies*, as already mentioned (p. 345).

This leads us to consider the mode of removal of *loose bodies* from the knee-joint, whatever be their ætiology, a question which has been already considered (p. 357). And, first, it may be pointed out that, if there be many such present, it is not desirable to attempt their removal at all. Not only would there be a difficulty in doing this, but we would probably, in such a case, be dealing with a joint in a very distinctly diseased condition, which would be most likely to reproduce such bodies again under the extra stimulus or irritation of an operation, however carefully carried out. It is only, then, when we have a small number to deal with that we attempt to free the articulation of them. This is best done by the direct method of incision, which is undoubtedly the most certain to effect what we want, and which in these days of antiseptic surgery has but few risks. The mode of procedure is as follows:—The loose body being fixed at one part of the joint (usually best over the external condyle) and firmly held by the fingers of an assistant, pressing it against the synovial pouch wall, the latter is cut down upon by one or two firm cuts with a sharp scalpel and through by cutting on the loose body. When the incision is free enough, and the latter quite unattached, it slips out usually with a sudden jerk, and the operation is finished, unless there be more than one. If so, and it do not present itself at once, the joint may be

[1] *Trans. Med.-Chir. Soc.* vol. lvi. p. 213. [2] *Lancet*, 1869.

carefully explored by passing the finger in through the opening, and then, when the other body or bodies is found, coaxing it with this and external manipulation towards and out of the opening. If, on the other hand, the loose cartilage be attached at one end, it must be drawn out of the opening with hooked forceps, and cut away at its pedicle. The wound may then be drawn together with a stitch or two, leaving a short piece of drain-tube in it for a few days, in case of effusion. But, if the whole operation have been conducted on strictly antiseptic principles, there will be little to fear from this, and in the simpler operation it is better to dispense with the drain-tube, leaving in at most a few horse-hairs. If, however, any unfortunate contamination of the joint should take place, and acute suppurative inflammation supervene, the part must be treated on ordinary principles (p. 335), always remembering that early and effectual drainage by incision is the first consideration. After the removal of the loose bodies and application of the antiseptic dressing, the limb must be kept at perfect rest until the external wound is healed, when it may be gradually exercised, first by passive then by active movement.

The indirect method, which is less employed for the removal of loose bodies from the knee now than formerly, has been already described, as far as is necessary (p. 358).

We have now to consider briefly another condition of the knee, which produces symptoms closely resembling those present in the last affection. This is that luxation, or subluxation, of one or other semilunar cartilage not unfrequently met with. It is not very easy to account in all cases for the occurrence of this lesion, but in others it is plainly due to some sudden and unexpected wrench of the joint. The evidence of its existence is as follows :—The patient, after some sudden and unusual twist of the knee, may be seized with a most agonising pain in the part, which he is now unable to extend fully and fixes in the flexed position. It remains thus fixed often for several hours, until the pain generally subsides, and the limb extends, when the joint may appear as well as ever, after a short period of stiffness or soreness, and perhaps trifling effusion. But sooner or later such attacks recur, often over and over again, with increased frequency, the patient becoming more or less crippled in consequence. If, during the stage of flexion and fixation, the joint be examined, the border of the displaced meniscus may often be felt thrust outwards against the capsule. What has occurred in these cases is this : the looseness of the semilunar cartilage has enabled it to slip between femur and tibia where the joint is flexed, but in an unusual way, so as not to slip out of the way during extension. The consequence is, that it becomes nipped tightly between the two bones, which, as extension is completed, are held apart by it, thus putting all the more tense ligaments of the joint on the stretch, and causing the pain complained of. The latter is similar in character, but not so severe in degree, as that present with loose bodies.

In the treatment of this condition, two points have to be considered : first, how to overcome the fixed flexion of the knee and restore the meniscus to its normal position; second, how to prevent recurrence of the luxation. In reference to the first requirement, it may be frankly said that we have learned something from the so-called 'bone-setters.' Their blind wrench to straighten the limb has been so often followed by complete reduction of the cartilage at once, and restoration of the movements of the knee on the spot, that this treatment of forced extension, intelligently applied, has come into regular use. In a given case, then, where the knee is fixed in flexion, the patient should be put under the influence of an anæsthetic ; the surgeon then grasping the ankle, with his right hand, and placing the left on the affected knee, should make forcible sudden extension (after momentary increase of the flexion), when the cartilage will be found to slip into its place. After this, the patient will be able to walk, but should rest the joint for a day or two while soreness remains.

The next point to be guarded against is the slipping out again of the meniscus, during some sudden movement of the joint. This is prevented to some extent by the use of an elastic kneecap or bandage, which, by supporting the capsular structures around the semilunar cartilage, may serve to retain it in position. But very often this is inadequate, and attacks recur like the first, probably owing to a relaxation of

the ligamentous structures, which hold the meniscus in its place. All that can be done in such cases, then, is to employ firm support for the knee as before, and in addition blistering, friction and douches. In some cases the capsular structures become very loose, indeed, with this condition and, as in the case of a young girl under my care some years ago, the lateral ligaments may become so stretched as actually to allow lateral rocking of the femur on the tibia. Such cases require very firm support indeed.

Affections of the Ankle.

The affections of the ankle to which we now turn require but little special notice on the whole. The most common are simple synovitis and strumous disease; and although the pyæmic, syphilitic, gouty, and chronic rheumatoid are often met with, they present no features here peculiar to the ankle-joint which need detain us.

From its exposed situation this joint is very liable to simple synovitis. This is ushered in by a little uneasiness and stiffness for a short time, succeeded by acute pain on movement, with local tenderness and redness. The part is at the same time swollen, the swelling being most marked over the sides of the joint in front of the lateral ligaments, where also fluctuation may be quite distinct. The ordinary position of the joint is not altered much in this case; but, if anything, the foot is a little pointed; it is, however, fixed, and active motion is avoided, passive being resisted.

The treatment is that described as suitable for synovitis elsewhere. But here we have no difficulty in giving the part rest, if need be, without preventing exercise—namely, by placing the limb on the affected side on an ordinary wooden pin or leg reaching from the knee, upon which he can walk about while the foot is at perfect rest.

The sub-acute and chronic forms of synovitis, as well as those due to sepsis, need no special description here.

Strumous disease presents the same general features here as in other joints. It may commence either in the ends of the bones, or the synovialis, and run the same course, as already described. If starting in the end of the tibia, there appears little reason why it should not be early recognised, and treated by removal of the diseased bone, by scraping, before the inflammation has spread to the joint proper. The swelling in the synovial form is most marked at either side of the joint in front and behind the lateral ligaments, and has the usual elastic feel to the finger.

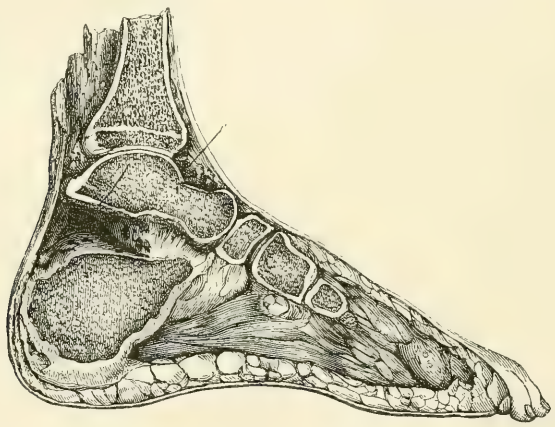
If the affection run on, and degeneration of the pulpy tissue take place, with the formation of fistulæ, these will also usually be found on the lateral aspect of the articulation, either in front or behind the tips of the malleoli. But before this has taken place the disease will, in many cases, have spread to the other articulations of the foot contiguous to it, and the original affection be masked by the newer changes. This is one of the reasons why excision of this articulation has, up to the present, been so sparingly practised in comparison with that of other joints, and amputation through the lower end of the tibia has been preferred, where the ankle-joint was diseased. But the more accurate knowledge of recent years as to the mode of the origin of the affection, and the improvements in the modes of wound-treatment, have worked a change here, and surgeons are beginning to look with more hopefulness upon the future of excision of the ankle-joint, and to perform the operation more frequently. Still there are not yet many who would quite endorse Professor Hueter's dictum when he says that 'the indications for excision of the talo-crural articulation have come when, together with synovitis granulosa, suppuration has declared itself.' In this country we are still inclined to rely in such a case rather upon free incision and drainage, with possibly scraping out of the diseased tissue with a sharp spoon, with careful antiseptic precautions, than upon any formal excision.

Affections of the Tarsal and Metatarsal Joints.

The diseases of the tarsal and tarso-metatarsal joints require no special description. They present no features differing from those of other joints, whether

they be simple, inflammatory, pyæmic, strumous, syphilitic, gouty, or rheumatoid. It is, on the whole, rare to find one of them exclusively affected, though such a condition is not by any means unknown, and may be met from time to time; as, for instance, in the calcaneo-astragaloid. This is not only due to the fact that several of the joints communicate by one common synovial membrane, but also that they exist under the same constitutional conditions, and are exposed to the same external influences all together. Here, as elsewhere, we find the morbid processes starting either in the synovial tissues or the bones, and perhaps also rarely in the ligamentous structures. But, wherever the starting-point is, there is a tendency for it to spread soon to all the structures around, until all are involved in the common change. When the disease starts in one of the smaller bones, however, it may possibly advance more rapidly towards a surface away from any of its articular facets, and show symptoms of its presence on the surface of the foot comparatively early. It is such cases that we should look out for, and treat early; for here we may be able to save the whole foot. Here we may choose either the excision of the whole bone, if we believe that the congestion starting in the small bone has already spread to the synovial structures of contiguous joints to a dangerous extent; or, we may be content to cut down upon the bone, and carefully scrape away the focus of disease from

Fig. 83.—Disease of the Tarsus, commencing in the joint, between the os-calcis and astragalus. (From a preparation in the Museum of St. George's Hospital.)



its centre, without trespassing on its surfaces, if these are found healthy. In some cases it is possible thus to scrape away almost the whole bone, leaving only a thin shell underneath the periosteum and encrusting cartilage. If free drainage of the resulting cavity be now provided for, and the part be kept perfectly free from all septic contamination, the hollow may fill up with healthy granulations, and these undergo fibrous or osseous development, until the whole bone becomes solid again. These operations of scraping out diseased bones are practically equal to sub-periosteal resections, as they are called, and afford better results, if carefully planned and conducted at an early stage of the disease, than any formal resection, as long as the bone alone is diseased. But, if the synovial structures are extensively involved, it is perhaps better to resort to wider removal, and to remove too much rather than too little. But here, too, in some early cases, free scraping with sharp spoons and thorough drainage will effectually arrest the spread of the affection. In advanced cases we shall still be called upon to perform amputation as heretofore, the prospect of reaching all the diseased structures, either by scraping or excision, being remote, and the dangers of exhaustion, general infection, and amyloid change in the internal organs being ever present. What is needed is very careful examination of the foot as early as possible, and when we are convinced that caseation is taking place in any bone or synovial tract, then free removal of that material, and even complete 'évidemment' (as it was called by Sédillot) of the affected bone, until nothing but its

superficial lamella is left, or complete riddance of the joint cavity of all diseased synovial tissue, if this be in question.

With the question of the formal excisions of particular tarsal or metatarsal joints we are not concerned here; they will be found treated of in the essay on Excision.

When the morbid process has not gone as far as caseation, but the rarefying osteitis or synovitis granulosa are present in their earlier stages, general attention to the strumous condition, with no local treatment beyond rest, is often sufficient for the recovery of the part. But that local treatment is as useful here as with other joints there is no doubt. How this should be carried out has already been generally considered. As to procuring rest for the part, this is perhaps best accomplished with those who are obliged to earn their living by providing them with a pin stump in which the knee can rest, and on which they can walk with the foot out of use for a long time. In other cases a plaster-of-Paris boot will steady the part better, while crutches will relieve the patient of the necessity of using the foot.

The only other joint of the foot which requires particular attention, and that only for a few moments, is the metacarpo-phalangeal of the great toe, the morbid conditions of which occasionally call for surgical interference. This joint is particularly liable to arthritis deformans and to gout, which, however, present no special peculiarities here. The treatment of the latter being generally considered as usually coming within the province of the physician may be passed over here, but it must occur to every surgeon, from time to time, to speculate whether this ought always to remain so, and whether the painful gouty disorganisation of this joint, as well as that produced by arthritis deformans, might not be met by a free excision or incision in the scraping out of the diseased structures. Hitherto this has been regarded with no favour in view of the diathesis which seems to interfere with proper plastic processes. But with our improved means of operation and wound-treatment in the present day, it is possible that we might obtain results far better than would have been hoped for some years ago, and with far less risks to the patient.

The last condition to be alluded is that produced in this joint by the use of ill-shapen shoes or boots which force the great toe into strong abduction and retain it thus. Where such perverted position has been maintained for long periods, the toe may give rise to much discomfort in walking by coming to lie either over or under the adjacent ones. The head of the metatarsal bone then forms a projection on the inner side of the foot, uncovered by the base of the phalanx, which is partially dislocated inwards. Very often the prominence thus formed becomes covered by a bursa which protects it somewhat. But sooner or later this bursa is apt to inflame, and, if so, becomes a source of much discomfort to the patient. In this state the ordinary treatment of adventitious bursæ may be sufficient, *i.e.* removal of the exciting cause, local antiphlogistics, incision and drainage, or excision of the offending sac. But very often the inflamed bursa will ulcerate into the joint as well as towards the surface, and in this case something more must be done. Probably the best treatment under these circumstances is to resect the joint with the bursa, and allow the two bones to unite in good position, thus effecting two very desirable objects: one, the removal of the cause of suppuration; and, secondly, the restoration of the toe to a straight line with the foot. But, even in those cases in which no suppuration exists either in the bursa or joint, but where the abducted toe is interfering greatly with the patient's comfort in walking, excision is quite justifiable. It must be remembered that the class of patients who usually suffer in this way can ill afford the time and expense necessary for a prolonged treatment by any of those ingenious orthopædic appliances for straightening the toe, such as have been designed, for instance, by Pitha and others. Under these circumstances excision of the head of the metatarsal bone has been practised with the best results by Hamilton, Rose, Hueter, and others. It is a simple operation, and can be performed without injury to the tendinous sheaths, a danger we cannot be too careful to avoid. A straight incision on the outer side of the joint, in the direction of the metatarsal bone, gives access to the head of the latter, which can then be removed by saw or bone forceps. The phalanx is then brought straight, and is retained thus on a splint, with

an antiseptic dressing over all. If the healing process run its course undisturbed, as it probably will do if the strictest cleanliness be observed, the result is a source of great comfort to the patient.

Corresponding deformities of the smaller toes, if present, are perhaps best dealt with by amputation if productive of great discomfort. Such a deformed member is of little importance to a patient, and its removal can in no way interfere with good locomotion.

Affections of the Shoulder.

Turning now to the upper extremity, we find a very plain repetition of what has been noticed in the lower, the same diseases leading to analogous results.

Taking the shoulder first, we have a simple synovitis in its various forms, pyæmic synovitis in its several varieties, strumous and syphilitic disease, and that known as arthritis deformans.

Of *simple synovitis* of this joint, it need only be remarked that, in addition to all the subjective symptoms of the affection already enumerated, there are a few objective peculiar to the part in question. First, it must be noted that fluctuation in this joint is not so easy to discover as in others, on account of the thick covering of muscle which envelops it. On its axillary aspect we may, however, detect fulness when the arm is slightly drawn away from the side. But, even without this, we can determine the presence of synovitis in other ways, and especially by the fixation of the scapula to the humerus. The latter is so freely movable on the former, and this on the trunk normally, that deviations from this norm are more easily detected. In the case of the shoulder, there is no distortion of the joint with synovitis; that is, no one part of the inflamed capsular structure requires to be relaxed for its relief more than another. All that the patient is anxious to do here, and does from the first involuntarily, is to fix the joint. In such a case the arm may perhaps be brought fairly well from the side, by the surgeon, without producing pain, or carried forwards or backwards, and at the first glance the joint might be thought free. But, on placing the hand on the scapula, it will be found that all the motion is through its free play upon the ribs, moving with the humerus. If it be fixed with the hand, and an attempt be made to move the arm in any direction, the latter will be found fixed, and pain will be produced. If, on the other hand, the humerus can be rotated freely while the scapula is held immovable with the hand, the subjective symptoms present are not those of synovitis; with immobility of the joint they can mean nothing else in recent cases.

In the treatment of the affection here we have less difficulties to contend with than elsewhere. The joint holds the same position, whether inflamed or not, and is maintained thus at rest with comparative ease by simply placing the forearm in a sling. It is easily accessible for local treatment, such as already advised (p. 335), and whatever is done in this direction, the patient is able to enjoy all the benefits of fresh air and exercise all the time. But, if adhesion remain between or about the surfaces, difficulties in restoring motion are met with in the shoulder which are not present to the same extent in other joints. These are due to the mobility of the scapula, which, when we attempt to make passive motion, for the stretching or tearing of the new material, moves with the bones, and we have no '*point d'appui*' as in other joints. But the difficulty can to some extent be overcome if the patient be put under the influence of an anæsthetic, by giving the scapula into the charge of an assistant, who stands at the side of the patient opposite to the affected joint. If now while he grasps this bone with both hands, and fixes it against the ribs with his fingers on its borders, the humerus be slowly brought away from the side, and then rotated on its own axis, the adhesion may be gradually loosened after one or two attempts if the assistant be able to hold the scapula firmly. Unfortunately, the patient himself will not, as a rule, carry out active motion carefully. He may think that he is doing so, but the instinct to fix the painful part, and the mobility of the shoulder-blade, lead him rather to move the latter with the arm than the arm on the latter.

The *simple sub-acute* and *chronic* forms of the disease here require no special description after what has been said above.

Strumous disease is, on the whole, not so common in the shoulder as in the lower extremity. There are probably many reasons for this, among which the following may be mentioned. The joint is less exposed to atmospheric changes than either the knee or ankle, being usually well covered with clothes, as well as by the thick deltoid muscle; its circulation and the consequent vitality of its tissues are maintained thus more evenly than in these joints. And, though the shoulder is exposed very frequently to violence of greater or less degree, it must be remembered that the great mobility of the scapula secures it from the evil effects of this to a large extent. A blow upon the shoulder is spent in forcing the scapula in one direction or another, rather than in damaging the articular structures. In the case of the hip, which is equally well covered by muscle and clothing, this is not so, any jars on the trochanter or the lower limb falling notably on the joint, with the resistance of the firm pelvis behind it.

But the affection is by no means rare. When it does develop, it is *usually* in the synovial tissues, here in the first instance, and if the bones become diseased, it is secondarily. This is possibly accounted for by the fact that in this joint the exposure to strain or injury upon the epiphysial tissues is reduced to almost nil by its mechanical construction. The first symptom will be uneasiness in the joint, and presently stiffness, the scapula and humerus moving as a whole. The entire shoulder then gradually becomes swollen, with the same general subjective and objective symptoms in a sub-acute degree, to those we have seen to be present in the simple form of the affection (p. 334).

Of the treatment of this disease, both constitutional and local, little special need be said, except that, from the position of the parts, it is perhaps more easy to deal with locally than other articulations, rest being easily secured in good position. Even when it becomes much disorganised, by softening and suppuration, there are less difficulties connected with its efficient and antiseptic drainage than elsewhere. The point usually chosen for incision, where drainage, with or without free scraping out of the diseased tissues, is desired, is in front, along the inner border of the deltoid muscle, where the inflammatory matters present. Sometimes, however, they point behind, and may be removed by a vertical incision. Occasionally, however, the articulation does become so completely disorganised as to call for resection or amputation (see 'Excision' and 'Amputation').

Strumous disease of this joint may also arise in inflammation seated in the epiphysis of the head of the bone, for the special description of which the reader is referred to the special paragraph on 'Epiphysitis' (p. 353). In the early stages of the latter affection the diagnosis is easily made on observing that the movements of the joint are perfect and painless, while the head of the bone is tender on pressure, or on being struck on the elbow; but later on there is much difficulty in the matter, owing to the fact that the disease, if it reach the periphery of the epiphysis, must almost necessarily invade the joint, the growing line lying within the capsule. It may, however, spread towards the shaft, and eventually reach the surface of the bone external to the capsule, the joint being thus saved.

In early infancy there are, it should be remembered, several forms of epiphysitis at the head of the humerus, which may be the starting-point of disease in the shoulder-joint, although they do not in all cases *necessarily* involve it to any extent. These diseases, arising from injury, infantile pyæmia, struma, or syphilis, have been already alluded to (see 'Epiphysitis'). It is only necessary to add that they should be looked out for carefully here, for it is quite possible that in the future a more rapid and certain diagnosis, the result of familiarity with the diseases, may enable us to treat them at a stage when the joint may be saved from those disastrous changes so often met with from spread of the morbid condition to its surfaces not originally implicated.

Another affection, sometimes taken for trouble in the joint, is inflammation of the bursa under the deltoid. A careful examination, however, of the other aspects of

the articulation, taken with the history, and the painless motion in the joint, serve to distinguish the two conditions from one another.

Arthritis deformans is met with very frequently in the shoulder, and may lead to great fixation of the joint, and enlargement; but the disease presents no peculiarities here which call for special description.

This joint is not unfrequently the seat of *septic synovitis* in any of its forms (p. 337) which will present the same features here as elsewhere. These affections hardly require, therefore, any special description, and their treatment will be carried out on the principles which have already been considered (p. 339).

Affections of the Elbow.

The elbow-joint, now to be considered, is very frequently the seat of disease, usually of the inflammatory type. Its functional activity and exposed situation would lead us to expect this. Still it appears to be less often diseased than its analogue, the knee, probably on account of the scapular mobility acting here, as it were, as a buffer during any violence to the arm.

Simple acute synovitis, as exhibited in the elbow, is accompanied by a considerable alteration in the usual form and position of the joint. On the front little or nothing is noticed, but on either side of the olecranon, behind, and over the head of the radius, there is considerable fulness, and even fluctuation, and the part is held in a position of slight flexion and half pronation. Any attempt to alter this is accompanied with much pain. Except in very acute cases, there is not much general redness of the whole circumference of the joint. The diagnosis can hardly give much difficulty, the disease being unlikely to be mistaken for anything else, except perhaps acute inflammation of the bursa over the olecranon. Here, however, the rotation of the radius will be unaffected, and though flexion to any extent may be resisted, what motion there is does not produce pain in the joint.

The treatment is conducted on the general principles noticed (p. 335), and as rest is easily secured for this joint, is easier to carry out than in many other situations. The forearm should be flexed to a little less than a right angle, and placed on a splint or in a sling with the hand in mid-pronation. The joint itself can be left exposed for any applications that may be thought necessary (p. 335). If these be applied with judgment, and the patient be ordinarily robust, the prognosis is good, the joint before long recovering completely. If not so, the affection is apt to become chronic, and then we have often an organisation of plastic matter gradually effused into and around the joint, with resulting stiffness, if not actual synostosis. The treatment of this latter condition, after all inflammation has subsided, depends upon the position in which the limb has become fixed. If at an angle somewhat less than a right angle, and so that the different parts of the head can be reached with the hand, it is perhaps well in many cases to be satisfied with the stiff limb, which will always be very useful. If, on the other hand, the limb be fixed at an obtuse angle or straight, it will be so awkward and comparatively useless that excision of the anchylosed joint, and the formation of either a false movable one or re-establishment of anchylosis at a proper angle, is called for. But the latter result is not usually aimed at in these days of carefully conducted excisions. But, if the fixation is merely due to some moderate degree of adhesion about the articular or peri-articular surfaces, the joint may be rendered useful again after all signs of inflammation are gone, either by sudden breaking down of these adhesions under an anæsthetic, or, by gradually stretching them or rubbing them away by constant passive motion.

Of *simple sub-acute* and *chronic synovitis* of the elbow little need be said here, the first differing only in degree of symptom and effect from that form of disease just described, the latter presenting but few points of difference, except as to ætiology, from the *strumous* form which must now engage us for a few moments.

This affection is a very common one for the same reasons that it is so in the knee (see p. 378). It usually appears to commence here in the synovial structures, more rarely in the bones, so far as we know. It may be, however, that closer study in the

future will show the bone to be more frequently the starting-point than has been generally supposed hitherto. Be that as it may, before the disease has been long in the joint, the bony surfaces of the latter become involved, and can be felt to grate more or less one upon the other. It may be necessary to place the patient under an anæsthetic in order to ascertain this, but not always, for the change is not an acute one as a rule, and the synovitis present produces but moderate tenderness. The limb will usually assume the same position as in the simple affection (see *sup.*) and present the same appearance, except that, instead of any redness, it will be usually uniformly pale and perhaps glazed. The symptoms here will not differ materially from those mentioned as present in other joints. The granulation-tissue is liable to undergo the same changes, leading to suppuration and sinuses, as elsewhere, and these openings will form on any aspect of the joint. It does not follow, however, that they shall penetrate the latter: very frequently softening goes on outside, and the fluid matter formed escapes through holes in the skin, without making its way into the articulation at all. When bone begins to be involved, it is not usually difficult to discover which of the three forming the joint is the starting-point, by close attention to history and symptoms. The rotation of the radius upon the outer condyle, for instance, is often found perfect, without roughness or grating, while the latter are perfectly clear on flexion and extension. Again, if the ulna be alone implicated, the swelling will be more marked over its extremity than over the end of the humerus, and *vice versâ*.

Of the treatment of a well-marked case of strumous disease of the elbow little need be specially said here. Surgeons are more and more inclining to the belief that early excision is the proper practice for such cases where the bone is involved. When they recover without operation, it is usually only after a long time, and usually with a stiff joint. When recovery takes place after excision, the worst result is a likewise stiff joint, but the repair is more rapid than in the previous instance. On the other hand, in a large proportion of cases (larger than where excision has not been performed), an excellent result as regards movement and strength is achieved. Incision or drainage is not in favour here. In the milder cases, the general or local treatment mentioned already (p. 343) will be sufficient, and with care the joint will retain its mobility; but where the disease is once well marked, excision holds out the best prospect to the patient.

The *pyæmic* affections of this joint, though common, need no particular description, as their features are those already studied in other articulations (p. 338).

Arthritis deformans is not infrequent here. It presents no points requiring special notice, however. The symptoms are the same as elsewhere; weakness and limitation of movement being most complained of. For treatment see p. 347.

It should be remembered that next to the knee this is the most frequent habitat of those loose bodies, the ætiology and treatment of which have been already considered (p. 355). The incision for their removal here should be made on the outer aspect of the joint.

Affections of the Wrist.

In the wrist-joint the affections most usually met with are the simple acute, the gonorrhœal, and the strumous synovitis; arthritis deformans is also encountered occasionally, especially in females, but is not very common. But when the wrist-joint proper is affected with any of these changes, the adjacent carpal articulations are usually included likewise. In most cases, however, it is for practical purposes unnecessary to distinguish between these synovial tracts, and we may now consider them altogether.

Acute synovitis is perhaps productive of more pain here than in any other articulation in the body, owing apparently to the fact that the joint or joints are naturally so difficult to immobilise, and that the whole hand is so highly organised. The swelling and redness are most marked on the dorsal aspect of the wrist, which is fixed in a slightly flexed position. Any attempt to move the part produces very acute suffer-

ing. At the same time, in uncomplicated cases, the fingers can be flexed and extended without pain. But not uncommonly the sheaths of the tendons passing over the wrist are more or less inflamed too, and in this case the whole hand is fixed. This is more often met with in the pyæmic or gonorrhœal form than in the simple. The stiffness remaining after subsidence of the inflammation in the first case is usually not great, but in the latter, where the sheaths have been implicated, is very marked, and inclines to resist treatment in a stubborn way. The latter is based upon ordinary principles, with the addition of gently increasing passive motion as soon as ever the patient can bear it.

When *strumous* change affects the wrist or carpal joints, the disease usually appears to start in the synovial structures, and generally runs its course to destruction of the surfaces of the articulations before long. Undoubtedly, however, the bones, too, are often the seat of the primary disease, which spreads to the surfaces in the usual way from the growing points. As in simple synovitis, the alteration of shape is best seen on the dorsal aspect, where the usual elastic white swelling is found, the position of the hand being that of slight flexion. Here, however, it is, on the whole, rare to find the sheaths of the bones involved, unless the condition be far advanced, and even so the fingers may often be moved freely without any pain. I have at present under my care a case of a young woman in which the wrist is enormously enlarged, with free grating in the joint, and yet the patient feels no pain in using the fingers freely. Not unfrequently, when the disease is seated in the bones, and softening takes place, the products of the process are discharged through the dorsal skin, and neither involve the joints nor the tendon sheaths in the first instance. Such cases should be watched and treated carefully, lest the articular surfaces should become secondarily involved.

Beyond the ordinary treatment for struma, nothing special is called for here in the simpler cases; but where the bone is slightly affected, incision and free scraping away of the diseased tissues will probably arrest the spread of the morbid action. Many cases recover, complete rest being easily obtainable and access to the part for local applications being free. But in a certain proportion of cases, extensive disorganisation of the joint surfaces takes place, and the choice between excision and amputation is forced upon us.

Arthritis deformans is met with in the wrist-joint, but, as a rule, only when several of the other joints of the body are similarly affected. The affection is said to be more frequent here among females than males. It calls for no further special comment (see p. 347).

The metacarpal and phalangeal joints are sometimes affected with the diseases we have been considering above, but require no special consideration, either as to ætiology or treatment.

Of the remaining diarthrodal joints not already considered, *e.g.* those of the vertebra, ribs, jaw, and clavicle, it may be said that, though they may be undoubtedly affected with the diseases we have been considering, especially with the various forms of septic synovitis and arthritis deformans, there is little special in the mode in which they are involved.

Affections of the Temporo-maxillary Joint.

The temporo-maxillary articulation enjoys, on the whole, considerable immunity from disease. There are, however, some affections to which it appears somewhat prone. One of these is arthritis deformans, which, in some cases, reaches such a pitch that the movements of the jaw are seriously interfered with, or even completely prevented. The ætiology, symptoms, and treatment of this disease here require no special discussion, being as elsewhere. It may be noted, however, that anchylosis in this case has been treated by resection of the joint (Humphrey).

The ordinary forms of synovial disease are rarely met with here, but those due to the pyæmic state are occasionally found. There is another to which very little attention has been called in books, but which I have often had an opportunity of observing,

and sometimes of dissecting after death. This is that disease produced in the articulation by suppuration in the middle ear. This is only met with in children, and is due to the presence, in many young persons, of a hiatus in that part of the tympanic plate which forms the floor of the meatus and roof of the articulation, and which is always present at a very early age, but persists sometimes as long as into adult life. This hiatus lies just outside the tympanic ring on the floor of the meatus, and if the latter, after an attack of otitis media, be constantly bathed in fœtid pus, softening of the thin membrane, by which the gap is filled up, often takes place, and thus the pus gains access to the joint, producing a secondary synovitis of a most destructive form. This I have seen, and within the last month I have had a little girl under my care at University College Hospital, in whom extensive necrosis of the ramus of the jaw commenced in this way, the ear having been neglected. After prolonged treatment and several operations by one of my colleagues, the sinuses over the ramus healed, but the ear continued to discharge copiously. When she came to me recently for treatment, I could see a large piece of loose dead bone in the meatus, and on removing it by gentle traction, found it to be the condyle of the jaw entire, which had made its way up into the meatus through the tympanic plate, where the latter was destroyed. Such cases must be borne in mind as illustrating one of the many dangers of chronic otitis media purulenta.

Beyond these diseases, and that affection known as subluxation of the intermaxillary cartilage which is described in the essay on Injuries of the Face, there is no special condition of the joint which need detain us further.

Affections of the Symphysis Pubis.

A few words now remain to be said regarding what are known as the amphiarthrodial joints. Among these it is rare, on the whole, to find disease, for reasons alluded to on p. 333, and it is only necessary to refer to the most important. Among these may be reckoned the articulations between the bodies of the vertebræ, the pubic and sacro-iliac synchondrosis. The first of these are considered sufficiently in treating of the spine (see 'Spinal Disease'); of the latter, disease of the pubic articulation is least commom. In pyæmia, especially during the puerperal state, inflammation is occasionally observed, caused as in other joints, and running the same course even to suppuration. In such a case the abscess will point on the mons veneris on one side or run up the rectus muscle. It will be treated on ordinary principles.

Strumous disease of the part is also rarely met with, and will present many of the same symptoms in a milder form. It has only fallen to my lot to see one case of primary caries of the joint. This was in a young female of about 23, who came into University College Hospital with a sinus over the ramus of the pubis. She died shortly after admission, suddenly, during an attack of vomiting, and at the autopsy I found the cause to be rupture of the œsophagus. The pubic joint was quite carious, and movable, a sinus running upwards and outwards over the ramus. The cause was obscure, as a history was not obtained.

The special treatment of such conditions would consist in rest in the horizontal position, nothing short of this offering much prospect of rest for the joint, unless, perhaps, a broad plaster-of-Paris corset, including the whole pelvis, should be applicable where no sinuses exist.

Sacro-iliac Disease.

Sacro-iliac disease is distinctly more frequent than that of the last-mentioned joint, though still a rare affection, on the whole. It may be mentioned, as bearing on this point, that during the last ten years, 1871-1880, only thirteen cases of this affection have been treated in University Hospital; these, with, in addition, two cases at present in the house, constitute but a very small percentage of the mass of joint diseases treated in the same time. Among these 13 cases, 5 were males, 8 females, the ages ranging from 15 to 52, the average being 27.

The results of treatment in these cases have not been encouraging: 1 is noted as cured, 3 as having died, one of these shortly after leaving the hospital; in the two others it fell to my lot to make the post-mortem examination; 5 are stated to be relieved, 3 unrelieved; 1 uncertain, and of those cases noted as 'relieved' it is questionable whether the benefit was not merely temporary, and likely to be followed by exhaustive suppuration, as also in those marked as 'unrelieved' (3). In the cases now in hospital I have aspirated large abscesses, several times in one, and this has been repeated by one of my colleagues, the patient lying now in a very critical state.

The causation of the disease is, no doubt, at least twofold. It may originate in injury or in struma. In one of the cases mentioned above, where the patient was under my own observation from the very beginning of the ailment until death, there was no history whatever of injury, and yet the course of the disease was very rapid, the whole joint being destroyed in a few months, with extensive suppuration requiring six aspirations, the patient ultimately dying of exhaustion and phthisis. At the autopsy I found the joint quite loose, and the fibro-cartilage destroyed. This was probably a case of the true strumous disease. In other cases it appears equally clear that injury is the cause of the disease. In rare cases it is said to be pyæmic, but this I have never seen.

The symptoms upon which a diagnosis of the affection has to be based are very various, and as success in the future in treating it will be in proportion to its early recognition, we must study in the first place that class of symptoms earliest observable, namely the subjective.

The first thing complained of by the patient is usually weakness in the lower part of the back, a feeling of insecurity in walking, and of great fatigue on doing so. The next will probably be pain, but in a number of different situations. First, and very commonly, over the articulation itself, usually on its posterior aspect. This may be increased, in some cases, by pressing the crests of the ossa ilii towards each other or pushing the sacrum forwards. But this is not found in very early cases, *i.e.* just those we are most anxious to diagnose. For here it may be that only one border of the articulation is eroded (as in the second case I examined after death), the rest of it remaining as firm as ever. In such a case, pressure in the directions indicated may not produce the slightest pain. But the pain is frequently referred to the course of the sciatic nerve, or its branches. This was notably instanced in the case just mentioned, which was, indeed, treated as one of sciatica. After a time a small collection of pus was evacuated from what was supposed by the surgeon in charge to be an inflamed bursa over the great trochanter. After death, which occurred not long after, I traced this abscess inwards, along the pyriformis muscle through the sciatic notch, and then upwards, to the front of the sacro-iliac joint, where it was seen to originate in a comparatively small oval focus of caries, about $1 \times \frac{1}{2} \times \frac{1}{2}$ inch in dimensions. The cause of the sciatic irritation was thus made plain. Again, the pain may be referred to the front of the thigh, through irritation of the anterior crural nerve, when the disease has reached the front of the joint. This was well marked in the first case alluded to here, where I watched the patient from the beginning and aspirated frequently. The patient complained much of pain running down the front of the thigh to the knee. Indeed, in some cases this persistent pain in the knee has led to the erroneous diagnosis of disease of that joint or of the hip. This is especially likely to take place if the psoas should be irritated by proximity to the focus of inflammation, as is occasionally found. One of the cases now in hospital illustrates this difficulty of diagnosis. It is met by observing the position of the limb, the movements of the joint, and where the pain is seated during the latter, whether in the position of the psoas or articulation; also by palpation of the latter on both its anterior and posterior aspect.

As to the objective symptoms, they are few in the earlier stages of the disease. The psoas may be a little contracted, flexing the knee slightly. This, and a slight limp, will be all that is noticed. Later on, when abscess has formed, there is more to help us; but unfortunately the disease must now be regarded as far advanced, and very grave.

These collections will present in various situations. The most common point is

behind and directly over the joint, where at first a small round abscess forms, soon growing to something very considerable. Such an abscess, if aspirated, generally fills rapidly again, and, strangely enough, sometimes with gas in large quantities. In the first case alluded to above, as treated by the author, this was notably the case, the swelling being quite tympanitic. Each aspiration also drew off a large quantity of fœtid gas, before any pus came, although there was no external opening, and I always took the greatest precaution to cleanse my aspirator needle. I do not think that the gas was generated in the abscess itself, and have only been able to explain its presence by the proximity of the cæcum, lying on the front of the joint, from which, I believe, the gas was exhaled, although after death I could detect no trace of opening in the viscus itself. The passage of pus from the front of the sacro-iliac joint, along the small rotator muscles, to the trochanteric region has already been described (p. 398). In rarer cases it may pass along the iliacus muscle, and point over or under Poupart's ligament. Lastly, abscesses sometimes form under the glutæi muscles directly behind, or burst into the rectum in front.

The treatment of this affection must still be regarded as very unsatisfactory, the recoveries being, in the long run, rare, so far as we know. Rest is the first consideration. This is best secured by placing the patient in the recumbent position. And, however objectionable it may be to confine a sufferer thus for long periods, it is indispensable. For it is hard to conceive any appliance which should adequately support these joints with the patient in the erect position, the whole weight of the body being inevitably thrown upon them. If any appliance could assist in steadying the pelvis, that designed by my colleague, Mr. Christopher Heath, would probably be most likely to achieve this end. It consists in a strong girdle, which is strapped tightly round the pelvis, just above the trochanters, and provided with pads to press upon the pubis in front, and the sacrum behind. The plaster corset, brought well round the pelvic bones, would probably be of some use, too, if well fitted. But the objection to this is the impossibility of making any applications for the local treatment of the disease while the corset is in situ. Such applications would consist, in the first place, of the actual cautery, applied either in the linear or button form; then of blisters or Tr. Iodine.

Professor Hueter advocates the use here, as elsewhere, of hypodermic or intra-osseal injections of carbolic acid solutions (see p. 343). In earlier cases we may hope to do good with one or other of these remedies, alone or combined. But, as soon as pus has begun to form, they can do no good, and can only irritate our patient. In such a case all that is left to us is the removal of the pus as it is formed either by the aspirator (which is to be preferred as long as it can be used) or by antiseptic incision and drainage. In some few cases portions of carious bone may be reached through such a method, and scraped away with a sharp spoon or gouge; but the prospect in such cases is peculiarly bad. The usual result, sooner or later, is exhaustion, and death therefrom, if the patient escape the dangers of septic intoxication and its consequences.

Affections of the Sacro-Coccygeal Joint.

The sacro-coccygeal joint is but rarely the seat of disease, and then only as the result of injury, such as falling in the sitting posture upon some sharp ledge. It is usually met with among females, and may give rise to much suffering.

The symptoms of this affection, when acute, as described by Mr. Hilton (the author having seen but few cases), are, tenderness and heat about the joint, pain on defæcation and on sitting down or rising, as well as when direct pressure is made upon the spot, or the coccyx is moved backwards and forwards between the thumb externally, and the finger introduced into the rectum. If the disease be very acute, there will also be redness and swelling over the joint, and eventually fluctuation, if suppuration be the result.

The treatment here will be free leeching in the earlier stages, followed by hot belladonna fomentations, if the disease be acute. In milder cases, too, a few leeches

will do no harm, and may cut short a condition apt to become chronic. The patient in any case should be confined to the recumbent position, and should keep the bowels relaxed by medicine and the use of light diet. At the same time the general strength should be kept up with tonics, remembering that these bones are liable to caries. If pus form, it may be evacuated into the rectum by incision on the middle line. When all evidence of active inflammation has passed off, the patient usually suffers for a long time from tenderness on sitting down, as might be expected from the fact that the weight of the body presses to a considerable extent on this joint, and strains its ligaments. This condition may best be met by the use of an apparatus consisting of two ring pads, which fit severally upon the *tubera ischii* when the patient is seated. By means of these the patient is raised sufficiently to prevent pressure upon the tip of the coccyx, and is thus able to sit with comfort. While this is in use the part may be dealt with by flying blisters or painting with tincture of iodine, tonics being administered internally, and the bowels attended to, lest the motions should at any time become hard and necessitate straining in defæcation.

This affection must be distinguished from the coccydinia complained of by delicate females, possibly the result of some uterine or vaginal irritation. Here there is no local rise of temperature, and manipulation of the coccyx does not cause so much suffering, the joint being unaffected.

The treatment for this condition, with the omission of the active antiphlogistic remedies, will be almost the same, however, as in the last affection. If it fail after fair trial, especially in the direction of tonics, subcutaneous division of the ligamentous structures around the end and sides of the coccyx may be tried. This operation I have only seen once. It was, I believe, followed by some benefit.

Arthur E. Barker.

DISEASES OF THE SPINE.

PART I.

CARIES OF THE SPINE.

Pathology and Treatment.

IN this essay those affections of the spinal column due to disintegration of one or more of its structures will be considered, those produced independently of destructive action finding a place elsewhere in relation to 'rickets,' 'lateral curvature,' and rheumatoid arthritis. Here we have to deal with changes which in a majority of cases result unfortunately still in the deformity known as 'kyphosis' or 'angular curvature.' It is undesirable, however, that this term, indicative merely of a symptom, should be so frequently used to cover the affection which gives rise to it as is the case. The mind both of the public and our profession is thus too constantly directed to the consideration of the deformity alone, and not sufficiently to the essential nature of the primary lesion, or even quite away from the latter. The general result of this is that the disease is not so closely watched for as it should be in its very earliest stages where deformity is not yet noticeable, and, next, that when angular curvature is marked, it is often considered the most important feature of the case. It is better to speak of it as *caries of the spine*, and to study its pathology, symptoms, diagnosis, and treatment at a very early stage *before* angular curvature has resulted. The disease may be said to be far advanced when the latter is present, and should be under treatment, if possible, before it has had time to appear.

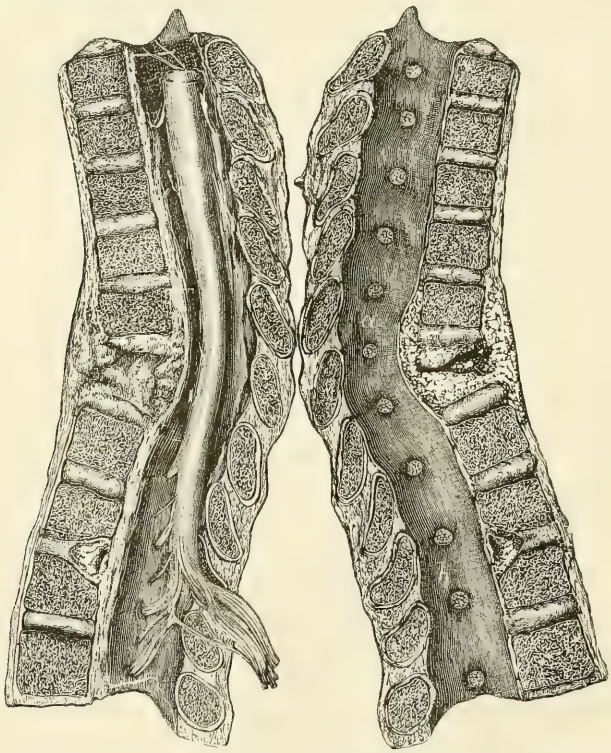
But in employing the term caries, in the sense in which we speak of it as occurring in other bones, we must carefully bear in mind that there are probably several distinct causes at work in its production, here and elsewhere. This is not the place, however, to go minutely into the question as to the relative importance of each of these factors. It will be enough if, in making use of the term here, we reserve it for the present for that affection commonly, but rather vaguely, spoken of as strumous caries. When we have considered this as it ordinarily presents itself, a paragraph will be devoted to an analogous affection manifestly due to the degeneration of syphilitic deposits in the vertebræ. In studying this condition so palpably syphilitic, we cannot avoid speculating how much of the disease commonly set down to the other causes may be due to syphilis. But beyond alluding thus briefly to these points we cannot go in an article such as the present.

Caries of the ordinary kind may commence in any of the bones of the spine from the atlas to the sacrum. But it is not found in every part of these bones to the same extent. Primarily it is limited in almost all cases to the bodies of the vertebræ, only involving the laminæ, transverse and spinous processes secondarily, if at all, as a rule. It must also be borne in mind that the disease may commence independently in several of the vertebral bodies by perfectly separate foci. This is well seen in fig. 84 from a specimen removed by the author from the body of a patient who had been under his care for a long time for another disease. There are probably several reasons for the bodies being the common starting-point of the affection. First, they bear most of the weight of the trunk in all its various postures, and are thus more liable to strain or injury than the other parts of the bone. Again, the latter contain but little medullary tissue in proportion to the bodies which are more

abundantly supplied with it than any other portion of the skeleton. This preponderance of soft, vascular, connective-tissue indicates greater physiological activity than exists in the compact substance of the laminæ, &c., and consequently (in agreement with the law that wherever physiological energy or growth is most active, there is the greatest proneness to inflammation), the bodies are more liable to inflammatory change than the laminæ, &c.

As to which of the vertebræ are most frequently affected opinions still differ, however. Billroth states that from his own statistics the starting-point appears most often to be the sixth, and next to this the fifth, seventh, and eighth dorsal. Hueter, on the other hand, regards the last dorsal and first lumbar vertebræ as most commonly affected, and from my own observation I am inclined to regard this as nearer the truth. In fact, the disposition to disease appears to diminish as we ascend the column, morbid change being least often met with in the cervical region.

Fig. 84.—Copied from a photograph of a preparation in the fresh state, placed later by the author in University College Museum. See also 'Path. Soc. Trans. 1882.' Card specimens.



Shows early disease of the vertebral bodies commencing *independently* at two parts of the column in a young child who had always been in arms, and had received no injury. Shows also that the starting-point may be on the *posterior* aspect of the bodies (*b*), which could not be affected by violence without injury at the same time to the anterior part. The dark lines at either surface of the softening spot (*b*) indicate the inflamed area of the bone around. The anterior part of the inter-vertebral disk (*b*) is healthy. The relations of both the anterior and posterior common ligaments to the broken-down material is well seen, as also that of the cord.

In this we have only another aspect of the general law just stated. For it has been established that growth of the spine is most rapid in the lumbar region, less so in the dorsal, and slowest of all in the cervical. The same law, too, applies to the age at which inflammatory changes are met with here. In by far the largest proportion of cases (in cervical disease I believe almost *always*) these date from childhood, when, as we know, the physiological hyperæmia connected with growth is most active. Occasionally, but rarely, spinal caries develops rapidly in adults, as the result of severe injury or syphilis; but hardly ever as a strumous affection amongst elderly people. Such cases as that recorded by Dr. Ogle,[1] where a well-known gentleman,

[1] *Path. Soc. Trans.* vol. xv. p. 20.

aged 73, developed rapid and fatal caries of the three upper cervical vertebræ, must be regarded as quite exceptional. And, in the absence of further details as to previous history, &c., than are furnished in the report quoted, one would not be justified in setting the case down as of truly strumous origin. Within the first year of life, however, it certainly is not commonly seen; but after this, and up to puberty, it is one of the familiar bone affections. The earliest age, so far as I know, at which its existence has been demonstrated, was shortly after birth, the child dying five weeks later of suppurative caries of the seventh cervical vertebra.[1] In this case the parents were healthy and non-syphilitic, and had had a healthy child before. But, from observation, I am inclined to think that, in infants and young children dying of tuberculosis, carious disease of the spine, without deformity, would often be found if only it were carefully looked for by section of the column.

But, though it is well known that any part of the column may become implicated in caries, there has hitherto been some difficulty, among pathologists, in agreeing as to which structure exactly the disease first commences in. This is probably owing to the fact that the disease is mostly looked for among those who die of spinal caries, where very extensive destruction has already taken place. Broadly stated, two views are commonly put forward upon this point, and sometimes as though they were totally antagonistic and irreconcilable. According to one, the disease starts in the ligamentous structures and spreads to the bones; according to the other, it originates in the bones, and only secondarily involves the ligaments. A little consideration of the normal histology of the parts will show that apparently a misapprehension lies at the root of this different description of the disease by different observers.

In the first place, it must be remembered that ligaments are rarely or ever the seat of primary disease of any kind, in any part of the body. They consist of fully-developed connective-tissue, which, having advanced a long way from its embryonic type, is consequently but little susceptible to morbid change. Where ligaments overlie synovial membrane or bone, they may, as is familiar to us, become secondarily involved in the inflammatory affections of either one or the other, but only in a passive way. In the case of the spine this rule applies as well to the anterior and posterior common ligament as to the intervertebral disks.

On the other hand, if it is contended that the affection starts in the bone, and spreads to the ligaments, the precise region in the bone ought to be defined. If this is done, the two supposedly adverse views converge towards the same point—namely, the deeper or growing layers of the periosteum, and of the encrusting cartilage, which might be supposed to belong to either the ligamentous structures which cover them or to the bone which they cover. In reality, of course, they are part of the latter. The fact is that in by far the largest proportion of cases the inflammation originates in this growing line of the bone, *i.e.* immediately underneath its periosteum, and (where it possesses a cartilaginous covering) at its juncture with the latter. In those rare cases where inflammatory disease of the spine originates in the adult, we have probably something wholly different before us, and it would be well to keep the two groups of cases quite distinct in our minds.

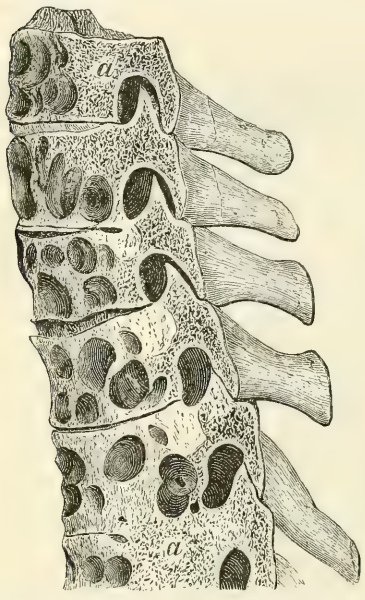
Starting, then, at this naturally hyperæmic line in obedience to the laws above referred to, inflammation may, on the one hand, spread more extensively towards the ligamentous structures, or on the other towards the underlying bone. In the first case, the appearances are often supposed to indicate that the disease has commenced in the former, but in the last that it has started in the bone. As a rule, however, it spreads more rapidly into the latter, owing to its being more vascular and containing more young connective-tissue (see p. 402).

Turning now to the primary morbid process itself, which results in this caries, we must study it first in the earliest stages in which it is possible to examine it. As a rule, opportunities of dissecting this form of spinal disease very early are rare. It is usually far advanced in destructive change before the patients succumb. But among a number of dissections, we are sure to find some in which at one spot or another, more or less remote from the primary focus, the morbid process has only

[1] Hjelt, *Virchow's Jahresb.* 1871, vol. ii. p. 384.

comparatively recently commenced. Such a case, among many others, I have had occasion to dissect carefully within the last few weeks. It is represented in fig. 84, taken from a photograph of the preparation in a fresh state (see also 'Path. Soc. Trans.' 1882).—I may mention that this is a comparatively rare specimen, in one respect particularly—*i.e.* it shows a distinctly isolated focus of caries starting on the *posterior* aspect of a vertebral body, the anterior and other parts of which are perfectly sound. The same condition of things due to syphilitic disease of the spine will be alluded to presently. This could not possibly have been the result of injury, as one is unable to suppose the back of a vertebral body being injured while the front was intact.—In these cases, the first thing noticed is a hyperæmia of and adjacent to the lines of growth of the body of the bone, *i.e.* just under its periosteum and encrusting cartilage. This hyperæmia is in character hardly more than passive. Indeed in young bones it is here, as elsewhere, hard to say positively in any given case, when examined early, where 'the physiological' ends and 'the pathological' begins. A little later on, however, an abnormal amount of young, soft granulation-tissue is found at the points indicated. At the periphery of the body—*e.g.* under the anterior, and possibly, as in the case just alluded to, the posterior common ligament (fig. 84, p. 402) or again underneath the encrusting cartilage—this will eventually form a soft bed, pressing against the bone substance, and increasing at the expense of the latter, bosses of granulation-tissue projecting into the body, here and there, and forming pits in it (fig. 85). The bone proper, however, has not been quiescent all this time; its medullary substance has begun to participate in the process, and has furnished part of the granulation-tissue. To put it briefly, inflammatory hyperplasia has caused the medulla to increase at the expense of the osseous trabeculæ enclosing it, which it absorbs by virtue of the vital action of its cells, aided by that of the bone corpuscles. In short, the structure is now invaded by a slowly advancing, rarefying osteitis, or, as it is also well called, an *osteo-myelitis granulosa*. That such a process may commence in the deeper parts of the bone occasionally, and spread outwards, appears probable; but that the course of the disease from the periphery towards the centre, as just described, is the rule we are taught both by experience and analogy. With the changes just described, there may or may not be suppuration. In the latter case, the condition was often spoken of by earlier writers as *caries sicca* or *fungosa*, but is perhaps now better described histologically as *rarefying osteitis* or *osteo-myelitis granulosa*. Here the whole of the body of one or more vertebræ may become slowly converted into a soft mass of granulation-tissue or inflamed medulla, with patches of caseation scattered through it, hardly a trace of osseous substance remaining; and yet all this without any pus-formation. What is now to become of this lowly-organised substance, short of its breaking down into a puriform fluid, depends upon a variety of circumstances. If the marked dyscrasia usually accompanying the local condition be early ameliorated or recovered from, a more or less complete *restitutio ad integrum* may result. The cells increase in vitality, the soft mass becomes organised, and, to be brief, goes through analogous changes to those observed in 'callus' in the repair of fracture, until the body

Fig. 85.—(From a dried specimen in University College Museum.)



Illustrates the effects of *osteo-myelitis granulosa* of the strumous form acting upon the front of the bodies of the vertebræ, and leaving the intervertebral disks intact. The latter are dried and shrunken in the specimen, but normal. The 'pitting' by pressure of bosses of granulation-tissue is well seen hollowing out the bodies, and starting underneath the anterior common ligament. The surface behind (*a*, *a*) is made by a saw-cut removing the transverse processes.

of the vertebra is again built up with true bone-tissue. But such a favourable course of things is very rare. It should be borne in mind, however, as the type of the healing process in this part which we are to aim at favouring by all known means.

Again, if the dyscrasia persist or increase, those parts of the mass most remote from active vascular supply undergo a change commonly spoken of as a loss of vitality, with consequent fatty degeneration, the result being the production of a caseous material at one spot or other. The mode of production of this material, however, is otherwise explained by competent pathologists, as we shall see presently. But, however formed, it may even now, under improved conditions of health, become absorbed to a great extent, the residue lying inert as a cheesy or cretaceous nodule in the midst of the recovered tissue. But with increase of ill health the process advances, the caseating change affects a larger and larger area, its products become more and more liquid, until eventually what is known as a cheesy abscess is the result—all this with little or no sensible disturbance of the temperature of the part.

Now if the process should have involved most or all of the body of a vertebra, the support to the spine anteriorly is consequently removed, and the bone above sinks down more or less upon the subjacent one. This movement is not of course sudden, but gradual, as the softening process advances, being most rapid if the patient have kept the upright position. While recumbent, the weight above having been taken off the affected spot, there may be little or no falling together. But when there is, rubbing and pressure of the diseased surfaces are produced, with consequent irritation, leading at last to hyperæmia, rise of temperature, and free formation of true pus. But, although the modes of origin of the caseous abscess and this latter fluid are primarily different, the two processes are usually associated in all but the very earliest disease. The subsequent behaviour of the resulting collections will be noticed lower down.

We turn now to the consideration of the *ætiology* of vertebral caries, a point upon which considerable difference of opinion still exists. The view hitherto commonly adopted in this country in regard to its causation may be briefly stated as follows: That it occurs only among particularly weakly children as a consequence of some violence to the column, whether by hyper-extension or flexion, by direct blow, or by a combination of any or all of these. Others, going a step farther, describe this weakliness as a distinct dyscrasia, characterised by low vitality of all the tissues, and a special liability to sluggish inflammation, a condition spoken of commonly, though vaguely, as the strumous or scrofulous diathesis. Here the violence, be it bruise or strain as the exciting cause is supposed to be followed by hyperæmia, gradually developing into a rarefying osteitis, with all its changes as described above. There is a great difficulty, however, in many cases in establishing the fact of any violence having occurred to the spine, and often where the disease is well marked it is beyond doubt distinctly negatived. This is one of the grounds upon which the theory of the origin of the disease in a specific poisonous irritant is favoured, a theory much more in vogue upon the Continent than in England. The exponents of this view (to state it briefly) regard scrofula as a definite septic disease, characterised by proneness to low inflammation of the growing tissues of the body, the result of irritants introduced into the body from without, and circulating in the blood. These irritants are nothing less, it is believed, than micrococci or microbia (to use the more general term of Pasteur) which have gained access to the body during some of those inflammatory conditions of the skin or mucous membrane so common in early life. These organisms, taken up by the lymph radicles in the first instance, are for the most part strained off, as it were, in the nearest lymphatic glands. It is by their aggregation and multiplication here that those cheesy masses so frequently found in glands, *e.g.* of the neck are supposed to be formed (Billroth). These caseous masses, then, are no longer regarded by pathologists holding this view as products of inflammation with secondary fatty degeneration, as first described by Virchow, but simply as colonies of microbia. They may, and usually do, eventually produce an inflammatory condition around them, but the material of which they are composed differs chemically and microscopically from the products of inflammation. Many of the microbia,

however, are supposed to escape the straining action of the glands, and thus gain admission to the general circulation. Arriving thus with the blood in the capillaries of the growing tissues, they not only interfere by blockage with the vitality of the latter, but act as direct irritants, producing either chronic congestion or (if aggregated in large numbers) actual so-called cheesy deposits. These may then induce inflammation around them, and themselves soften, leading to those ultimate results already mentioned. This aggregation of micrococci is held to be particularly favoured in bone by the arrangement of its vessels in wide lacunæ; hence the frequency of strumous disease of bone. It is further held that this scrofulous material may produce what is spoken of as true tubercle. Particles of the so-called cheesy deposits may be thrown off into the circulation, and be carried into some of the capillaries at a distance. Here they give rise to irritation and exudation of white corpuscles, which form around them soft miliary granulations, to which the name of 'tubercles' is given. This infection may either be a local one, the tubercles being formed close to the original focus of disease, or general, the characteristic deposit taking place at a distance, *e.g.* brain, lungs, or other organs. Kœster[1] appears to have been the first to draw attention to the frequent presence of these small bodies among the granulations of proliferating synovitis; their existence in bone is more difficult to demonstrate.

This theory regarding scrofula and its relation to tubercle has, at all events, the merit of clearness, and explains, if true, many difficulties, which without it are constantly recurring to the mind. Whether it is true or not must be decided by further reseach; but, meanwhile, it is an attractive hypothesis with which most of our known clinical facts will be found to harmonise. One of these, the occurrence of caries in bone, without any injury to account for it, has been already alluded to. That this may take place there can be little doubt. I myself have none from facts which I have observed; one of which appears particularly worth mentioning here. I have found, namely, a patch of caseating caries the size of a sixpence under the dura mater of the anterior fossa of the skull, close to the tip of the lesser wing of the sphenoid. This was in the case of a boy who died at University College Hospital with the most extensive caries of the spine I have ever seen. Again in (fig. 84, p. 402) a focus of disease about the size of a pea will be seen quite isolated on the posterior surface of the body of a vertebra. It is difficult to imagine any injury specially affecting this spot alone, and not the rest of the corresponding body, especially in a very young child like this. Another point telling in the same direction is the well-known frequency of general tuberculosis in those who have long had local deposits of strumous caseation.

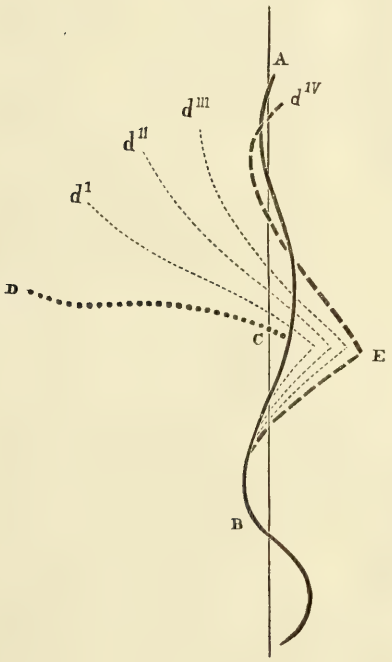
For my own part, in studying disease of the spine, I have formed the conclusion that it is in some cases, especially among adults, doubtless of simple traumatic origin, without any particular diathesis to help, but that in others, notably children, there may be no injury to account for the condition, and that here we are driven to the theory of struma or tubercle. The conception of the latter as specific diseases in the sense just described, and of their mutual relations to one another, appears to me moreover most valuable from many points of view, even if it be no more at present than an hypothesis.

Turning now to the *secondary changes* produced in the spine by the local disease just considered, the very frequent, but for the future *not inevitable*, deformity must first be noticed. This is the well-known angular projection backwards of the spinous processes corresponding to the diseased bodies. The latter, softened by rarefying osteitis, as described in pp. 404, 405, fail to support those above them, which, under the weight of the trunk aided by the action of the abdominal muscles, consequently approach the next soundest bone below that affected. This, of course, produces a curve forward of the spine, with corresponding projection of the posterior processes. To this is sometimes added a slight lateral curve (but only in the lower dorsal and lumbar region) if the disease have involved one side of the bone more than another; this may even be marked if one of the articular processes be implicated, but it is rare.

[1] Hueter, *Gelenkkrankheiten*, 2nd edit. 1876, p. 134.

But this is not all. The abrupt curve in the column now existing would bring that part of the trunk above it quite out of the perpendicular, and the centre of gravity of the body would lie much in front of its base of support, if no compensation in balance took place; moreover, the face would look downwards instead of forwards. To obviate both these faults, the patient involuntarily produces what is known as the 'compensatory curve' in those parts of the spine which are still unaffected. Thus, if the angular curvature be produced in the lower dorsal region, the patient involuntarily increases the normal lumbar curve, and so throws the upper part of the trunk backwards, and thus more over the base of support. At the same time the cervical curve is increased, and the concavity forwards of the upper dorsal region obliterated, if not converted into a concavity backwards, continuous with that of the neck. The head and shoulders are also thus brought into the perpendicular. Fig. 86

Fig. 86.



A, B, spine in profile; C, seat of disease; C, D, upper portion fallen forward; d^{i} d^{ii} d^{iii} d^{iv}, upper portion both elevated and carried back to the line of the centre of gravity; E, apex of angle moved backward.

Fig. 87.

The figure, copied from a photograph, shows the appearances commonly presented in a case of angular deformity from spinal disease. The patient, a delicate girl, fourteen years of age, had become deformed to the extent seen in the drawing, shortly before her admission into the hospital. She had been generally able to go about and attend school during the progress of the deformity. Latterly, she failed in her power of walking. But it was ascertained by frequent observation that this defect did not proceed from paraplegia; but only from inability to balance herself in the newly-deformed condition of the upper region of her body. She became strong on her limbs, after a short stay in the hospital.

is intended to represent this whole process diagrammatically, from the production of the angle to the establishment of the erect position of the deformed body. It must be remembered, however, that the process of deformation and that of compensation go on *pari passu*, and not at different times; also that the position of the compensatory curve differs with the situation of the disease. In fig. 87 it is seen in the lower dorsal region, the angular deformity being seated above.

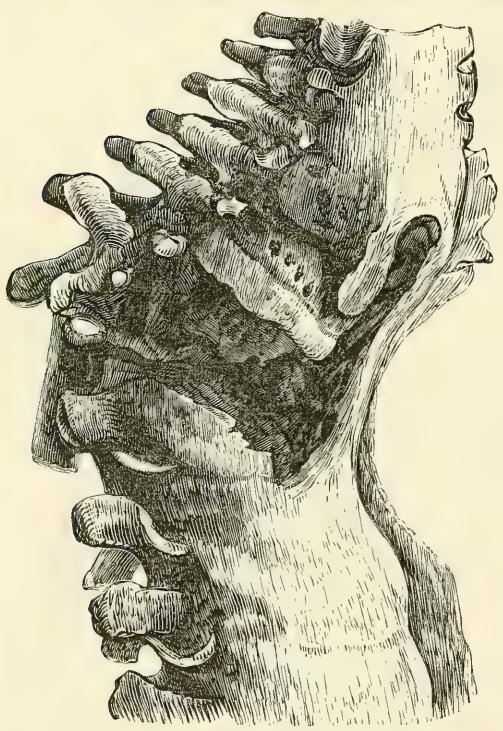
Our great aim, however, in the future must be to recognise the affection before any deformity has been produced. For it must be remembered, too, that *osteo-myelitis granulosa* may be present to a considerable extent, and yet no angular curvature exist. Thus we may find, after death, the front of one or more vertebral bodies eroded, pitted, and covered with soft granulation-tissue (fig. 85), or perhaps an extensive collection of pus, and yet the continuity of the column in no way affected.

Such cases must be borne in mind as explaining possible spinal abscesses where

no deformity exists. But between them and others where one or more bodies are completely destroyed (fig. 88) there is every possible gradation until, in place of erosion of the front of several bones, as described, we may find total destruction of perhaps six or eight vertebral bodies, and a consequent bend in the spine to the extent even of a right angle.

Now it may be taken as generally true that, wherever there is much deformity, there is sure to be an abscess somewhere, large or small. Whatever be the nature of the initial lesion, the destruction of tissue, increased mobility, and consequent irritation are almost certain to lead to the formation of pus. But it does not follow that this abscess shall point externally at once. It may not do so for a long time, or even not at all, being absorbable under a return of the part to favourable conditions for healing. Again, it may reform long after the part has consolidated, if the patient get into bad health, or meet with any slight overstrain of the diseased part. A knowledge of these points is necessary for proper treatment in different cases. The direction in which these abscesses enlarge and eventually point will of course depend upon the position of the carious focus, and will therefore be considered later on in relation to cervical, dorsal, and lumbar caries.

Fig. 88.



The patient from whom the specimen represented in the figure was removed was a blacksmith, twenty-eight years of age, and was admitted into the hospital for a psoas abscess, about the size of a large orange, situated in the left groin. He had an abrupt angular deformity in the back, with protuberance of the sternum; and his muscles, particularly those of the upper extremities, were largely developed. The deformity had taken place when he was fourteen years of age; and it had not increased since. His father being a blacksmith, he had been early put to the same work, and had continued uninterruptedly at it till three weeks before his admission, when he first noticed the swelling in the groin. On the abscess being tapped, a straw-coloured fluid was discharged; the opening did not heal; ordinary pus continued to flow; and he died exhausted with hectic fever. It will be remarked in the figure, that the posterior arches and articular processes of the vertebræ, at the seat of disease, have been firmly united together by bone. It may also be noticed that an intervertebral disk has been left untouched, while the bones above and below it are extensively destroyed.

The state of the spinal cord during the changes we have been considering now claims attention. As a matter of experience, its functions are ultimately but little interfered with in the majority of cases of the kind. As far as the mere shape of the column is concerned, this is only what we might expect when we come to examine into the mechanism of the change. When the canal is bent upon itself, in a case of caries, it is not a question of an abrupt 'buckling,' at one spot, such as is produced when a piece of tin tubing is forcibly bent. In such a case the 'buckling in' of the anterior wall towards the posterior would inevitably compress the cord. But here there is a loss of substance in the anterior wall of the canal, and when, as a consequence, the column falls forwards, the lumen of the tube is, if anything, larger than normal at the affected spot. Again, the shortening of the canal tends to relax the cord, and thus admits of its accommodating itself the more easily to its altered conditions. It is a remarkable fact, too, that, although one or more of the bodies may be totally destroyed, injury to the cord from actual dislocation is very rare. This is perhaps best explained by the gradual welding together of the parts by plastic matter effused around the carious spot, which usually takes place. Again, all care is taken by the patient himself to shield the part from every movement or violence,

and this being so, the other articulating portions of the bone are adequate to the lessened call made upon the strength of the part. Nerve symptoms are, however, observed from time to time with vertebral caries, and due to a variety of causes. They may be produced, it must be remembered, as well by altered conditions around and about the nerve-trunks leaving the cord as by damage to the latter itself. Thus many affections between complete paraplegia and slight loss of power or numbness in part of a limb are met with. The factors in the production of these nerve affections will probably be one or other of the following:—(1) The soft débris of advanced osteo-myelitis granulosa may be squeezed backwards against the posterior common ligament now relaxed (fig. 84, p. 402), and press it against the cord as the spine falls forwards, and the sound bone above closes down upon the diseased mass. (2) The same kind of pressure may similarly be exerted upon the nerve trunks as they pass through the intervertebral foramina, or after, and without affecting the cord. (3) The proximity of the focus of disease to either the cord or nerves may produce sufficient congestion or inflammatory effusion of serum about them to interfere with their functions by simple pressure. (4) In the same way, actual inflammation of these nervous structures may be produced, and go through any or all its stages, even to complete disorganisation, which is, however, rare. (5) Finally, an incautious movement of the spine may rupture an engorged vessel in the congested part, producing extravasation of blood and immediate compression of the nervous structures.

The diagnosis of these causes of nerve symptoms, one from the other, is often attended with considerable difficulty, but must nevertheless be studied, as upon its correctness depends, in many cases, the suitability of our treatment of the carious spine. Only the more general grounds for diagnosis will be alluded to here, however.

The *first* cause mentioned is, perhaps, not difficult to recognise. The symptoms are possibly only present if the patient is in the erect position, or are worse at such times. There is probably no pain in the limbs. If the diseased part be relieved of the weight of the body above it by lifting the latter, the pressure on the soft débris is removed at once, and the nervous symptoms disappear. This I have seen in patients with marked deformity, and inability to support themselves on their legs, when it has been necessary to partially suspend them for the application of a plaster corset. During, and after this, they have been quite relieved, and the relief has been complete, as long as the spine has been supported.

The *second* cause is diagnosed upon the same grounds, and by the limitation of the defective power to one or more nerves. These troubles are often met with in the arms with cervical caries.

The *third* cause is not easy of positive diagnosis. But here the symptoms will probably have set in rapidly after some exposure either to chill, exposure, or slight injury, in one who, though affected for some time with angular deformity, has up to that time shown no symptoms. There will be no sudden increase of the deformity or of pain on pressure, no pain or twitching in the parts whose nerve supply is affected; probably no rise of temperature.

With the *fourth* cause the symptoms are generally marked; the most important being as follows: pain at the diseased region of the spine, increased by movement or jarring of the part, and radiating along the course of the nerves given off here; hyperæsthesia at the peripheral distribution of the latter; twitchings of the muscles are also complained of before loss of their power in marked cases. The temperature of the body rises usually, and sometimes to an extreme degree.

The *fifth* cause is difficult to recognise in many cases, but may be tolerably apparent in others. The evidence is negative; no increase of pain, tenderness, or deformity of the spine is noticed. The loss of motion or sensation comes on rapidly, and without being preceded by muscular twitchings, pain along the nerves, or hyperæsthesia. The temperature is not affected.

As to the varieties of nerve conditions produced in the ways just alluded to, they have nothing further about them of special interest to the surgeon, and the detailed description of the ultimate changes induced through them in the cord, and their treatment in detail, must be left to the medical works devoted to this particular subject.

Having now considered the ætiology and general course of caries of the spine, there remain for study the *diagnosis*, *treatment*, and *prognosis* of it in the several regions of the column, in each of which it presents peculiarities. A few words, first, as to the *general* indications for treatment of the disease, will save reiteration when dealing with the three divisions separately.

Our success in the *treatment* of any case of spinal caries will be in proportion as we secure early local rest for the spot affected, and improve the general nutrition and vitality of the whole body. The mode of meeting the first of these requirements for each region of the spine will be dealt with in considering that particular part; the way of encouraging the latter now requires brief notice. Whether strumous disease originate in injury or the presence of microbia in the tissues, these bases of our treatment are equally sound. If the latter theory be correct, there is a constant struggle, so to speak, between these lower organisms and the cells of the human tissues. These, in a state of normal activity, are capable of resisting and overcoming their adversaries, but when their own vital force is lowered the reverse is the case.

It must be remembered, firstly, that in securing immunity from pain the nutrition of the body is indirectly improved. Pain means 'nerve wear and tear,' and this means loss of vital force affecting all the tissues; it means loss of sleep and appetite, and assimilative power. And it is remarkable how soon both the desire for food and the capability of assimilating it increase when, by simple mechanical support, the pain accompanying spinal caries is relieved. The same relief may be obtained by confining the patient to the recumbent position, and so relieving the column of all weight. And, in certain cases, especially with very young children, no doubt such treatment is the best we can employ. But, as a rule, the debility so induced by prolonged confinement militates strongly against repair, even though the disease cease to advance. Another evil, due to the horizontal position, is that passive congestion of the structures involved in the disease is favoured, unless the patient lie in the prone position. Moreover, if there be any pus present, it remains in contact with the diseased focus, or slowly sinks through the back muscles, instead of gravitating away from the carious spot, as is the case where the patient is enabled to preserve the erect position, and a psoas abscess forms. This natural drainage of the affected spot is of much importance. But, besides attention to these considerations, much remains to be done. Fresh air, light, suitable and sufficient food and clothing are called for. One of the great advantages of the various spinal supports is that it brings the first two of these items within the reach of almost all. The plaster-of-Paris corset enables the patient to take quiet out-door exercise on bright days, and often to escape ill-ventilated and overcrowded rooms in the case of the poorer classes. But it is a melancholy fact that we, whose hospital patients come from the poorer classes of the metropolis, are too often powerless to treat the disease, owing to the lack of the two other common necessaries of life, suitable and sufficient food and clothing, if the patient be treated, as ought to be the case, outside the hospital. What is wanted is increased accommodation in country 'Homes for the sick,' preferably at the seaside, where our cases might be left for months, and still receive skilled surgical care. The ideal home for such cases would be in a pure, dry atmosphere, bright, but sheltered, so as to admit of out-door exercise at all times of the year. There should be a full supply of light, nutritious food, into which fresh, well-cooked meat enters freely. Saccharine matters and the heavier fats would be avoided, as straining the digestive powers too much. On the other hand, certain of the lighter fats, especially if half-digested, or pancreatised, should be supplied abundantly, in the form of milk, fresh butter, and cod-liver oil.

As to the drugs which have been used internally in the constitutional treatment of struma or tuberculosis, they are numerous. Those most in use amongst surgeons are the various preparations of iron, phosphates of lime, iron, &c., but, above all, iodine, in several combinations. How this latter exerts such a beneficial influence over diseases of the strumous class is not established. Those who believe in the germ theory of scrofula, as given above, see an easy explanation of the fact in its known power as a germicide. Some of those who hold this view, report favourably also upon the local hypodermic injection of solutions of carbolic acid, in early cases.

into or around the diseased spot, on the same grounds. This treatment, as described by Prof. Hueter (*op. cit.* Th. iii. p. 85), one of its strongest advocates, is carried out for spinal disease as follows :—'The point of an hypodermic injection-needle is passed through the thick muscles of the back, at a point between the transverse and spinous processes until the posterior periosteal surface of the lamina is reached.' Then one gramme of 3 per cent. solution of carbolic acid is slowly injected into the tissues around the bone. This is repeated every day for a considerable period. This surgeon regards the effects of his treatment as undoubted even where, as is the case here, the diseased bone is not actually reached with the needle; this is made up for, he believes, by the diffusibility which carbolic acid is known to possess. The effects, however, where the needle can actually be thrust into the bone, as in disease of the end of the femur, are said to be more marked. What place this measure is eventually to take in surgical practice only long and extended experience in the future can determine.

As to the use of local antiphlogistics, such as are employed in the inflammatory bone affections elsewhere, they are not in favour at the present day in the treatment of myelitis granulosa of the vertebræ. Applications of ice, setons, blisters, and other counter-irritants have fallen almost completely into disuse. This is perhaps to be regretted in the case of some of the latter, where the treatment of very recent osteitis is in question. If recognised very early, we have as good reason to expect benefit here as elsewhere from free and repeated blistering, or the use of the actual cautery at either side of the spine, provided always the sore spots left do not interfere with apparatus for the immobilisation of the column. Later on in the disease this treatment could only be hurtful.

We have now to consider the peculiarities of strumous caries in the different regions of the spine.

CERVICAL REGION.

In the *cervical* portion it commences almost always in early life, though it may persist into adult age.[1] Here there is usually no history of injury, the affection starting without any assigned cause, and progressing slowly. The first sign of the disease noticed in the child will be a stiff cautious gait, the head being fixed and carried with the rest of the body, as the patient desires to look right or left. This is simply an involuntary act on the part of the patient, in order to protect the inflamed part from movement, and has no relation with the fixation, which takes place later from consolidation of plastic exudation around the focus of disease. At this time but little pain may be complained of, so long as the head is steady, but any attempt to active or passive motion of the part will produce much suffering. Here, however, the bodies of the vertebræ being so small, it is not long before they yield to the softening process, and the head bends slowly forwards; the chin approaches the root of the neck, and one or more of the spinous processes becomes prominent. The latter rarely form so sharp an angle here as elsewhere, owing to the fact that several vertebræ are usually involved in this case. What has been described as compensation is now noticed. This curve, produced involuntarily in the healthy part of the spine, to make up for the change of shape in the diseased part, is, in this case, situated in the dorsal region, whose normal concavity forwards may be obliterated, or even converted into a convexity to make up for the exaggerated curve forwards, now present in the cervical region. But for this compensation the chin would rest upon the neck, and the face look downwards. With it the patient can look fairly straight before him. A patient with marked angular curvature in the neck presents a most remarkable appearance, when stripped. Above, the head is seen hyper-extended, then comes the deformity, and from it downwards one long curve forwards of the whole column, involving both dorsal and lumbar regions. In the former the spines are seen sunk in between the shoulder-blades, which are abnormally prominent.

The next consequence of cervical caries noticed will probably be the formation of swelling of greater or less extent over the seat of disease,. It may be trifling for a

[1] Some anomalous cases of late origin of the disease are referred to on pp. 421*et seq.*

long time, giving little more than a sensation of increased resistance to the finger on palpation, or may rapidly increase and become doughy and brawny. Sometimes abscess is the first indication of mischief here, but rarely and only when the osteo-myelitis granulosa is limited to the anterior or lateral surfaces of the bodies. In such a case it will form a soft fluctuating or doughy swelling on the posterior wall of the pharynx, which may be reached with the finger. This may, however, increase to a size sufficient to produce dysphagia, or even dyspnœa, before attention is drawn to it. But, as a rule, abscesses in connection with cervical caries point in some part of the neck, at a distance often considerably below the seat of origin. The most usual position is in the posterior triangle of the neck, in front of the trapezius, or low down close to the outer border of the cleido-mastoid muscle. The reason for this is not far to seek, if we remember the direction of the planes of the cervical fascia, and its sheaths for the muscles running downwards and outwards from the neighbourhood of the focus of disease. Rarely, the pus passes directly backwards from the latter, and points at either side of the ligamentum nuchæ. A doughy swelling precedes its actual appearance for some time, and requires care in diagnosis. Occasionally, it happens that the pus does not point in the neck at all, but makes its way into the posterior mediastinum, sinking, perhaps, as far as the diaphragm. Here it may burst into the pleura or pericardium, or, running sideways or forwards, open externally under the border of the ribs. Again, it may run down outside the thorax, but under the clavicle, and burst externally. The chief immediate dangers of abscess from cervical caries are that it may rapidly induce dyspnœa, from swelling in the pharynx, or that it may burst here, producing suffocation from entry of the pus into the air-passages. And, even if this immediate peril be escaped, the patient may succumb later to broncho-pneumonia, induced by the entrance of pus into the lung. Apart from these, the remote dangers are less imminent when such an abscess opens within the pharynx than when it bursts on the surface of the body. The probability of septic changes in the latter case are much greater. For the general treatment of such abscesses, see p. 417.

The *diagnosis* of cervical caries is not difficult in its later stages; but it is so early in the disease, and here mistakes occasionally arise. And yet, if we are to be of real service to this class of patient, we must recognise their disease very early. The pain here causing restrained movement of the neck is apt sometimes to be taken for rheumatism, so often present in this part. It may be distinguished from the latter, however, by the fact that it is constant and gnawing, worse at night, is aggravated by movements or by pressure upon the top of the head, and relieved by lifting the latter upwards, while rheumatic pains are worse in the morning, are 'catching' in character, are relieved by moving the part about for a little, and by friction. With caries there will be deep-seated tenderness, too, on pressure, and probably some swelling and local rise of temperature. Close observation of the movements of the head, which produce suffering, may also help. Thus passive flexion will be more painful in the case of caries than with rheumatism. When an abscess has once formed, or deformity or nerve symptoms have appeared, there can be but little difficulty in diagnosis. The latter vary from slight aches or loss of power in the course of some of the cervical or brachial plexus of nerves to complete paraplegia. When the head is gently lifted and well supported, these symptoms disappear when observed early, often on the moment, and there are few more interesting or remarkable sights in our experience than to see this take place.

The *treatment* of cervical spine disease taxes all our powers. Apart from the general and local measures described already (see p. 410 *et seq.*), the only hope for the patient lies in complete rest of the part by immobilisation. But this is extremely difficult to secure, owing to the natural mobility of the neck, with, in addition, probable destruction of one or more of the bodies of the column. Here, then, is an extra reason for recognising the disease at its outset, and exerting ourselves to the utmost in its treatment. Of the many means which have been employed in the latter, only a few need be mentioned. Confinement to the couch is undesirable, for reasons already given (p. 410), and except in the case of very young children, for whom mechanical appliances are less suitable, should not be persisted in. Those appliances, then, which, by fixing the head and relieving the diseased spot of its weight, enable the

patient to obtain exercise in the vertical position, and fresh air, are designed on the soundest principles of treatment. We have here three more or less stable parts to work upon—the head, the shoulders, and the pelvis—and these are variously utilised for immobilising the cervical spine. Some of the earlier contrivances consisted simply of a high collar or stock of leather, gutta-percha, or pasteboard, resting below upon the broad part of the neck, and receiving upon its upper padded border the whole weight of the head, through the jaw and occiput. The latter is thus kept from flexion and extension to a considerable extent. This appliance, however, has manifest disadvantages, and is not in very much favour at present, though some still employ it, Professor Hueter speaking highly of it. It is, at all events, simple and cheap. But those appliances which take their base or support from the pelvis are generally regarded as the best. Of these, two typical examples only need be mentioned here.[1] One was designed many years ago by Dr. F. Taylor, of New York. It consists of a broad, well-padded pelvic-girdle made of iron, from which two steel bands ascend one on either side of the spinous processes as high as the occiput; here they terminate in a kind of crutch, which supports the latter and the chin, to which it can be adjusted by the action of screw-joints. These vertical rods are kept in position between the shoulders by straps which pass over and under the latter, and are prevented from galling any points of pressure by careful padding. This is an excellent contrivance, and has done good service in its time. In Professor Sayre's Plaster of Paris Corset and Jury-mast, however, we have a much better appliance, in so far as it provides a better support for the head, and, while preventing flexion, allows at the same time more freedom, as far as rotation of the latter is concerned. This movement takes place, of course, at the upper joints of the spine, and can be free without disturbing the disease below, unless these upper articulations themselves are affected, which is rare. Personally, I have no hesitation in giving the preference to this contrivance over all others, and this in spite of several disadvantages, to which all who have had large experience of its use must be fully alive. Some of these may be mentioned. In the first place, great care and considerable skill are required in the application of the corset; for, without this, it is not only most irksome in locomotion, but may cause serious embarrassment to both respiration and digestion, quite apart from the minor troubles of galling, even to ulceration. It requires to be reapplied every six or eight weeks to avoid the same evils, especially with growing children. Among the poorer classes, it often becomes infested with vermin, or otherwise very unclean. During its use, the hygiene of the bath must be foregone. When worn for a very long time, I think I have noticed that the patient contracts a habit of breathing almost exclusively by the diaphragm, owing to the close fit of the corset, and even when this is not tight, simply for the reason that it involves less exertion than that of lifting the thorax inside this firm carapace with each inspiration. The consequence is an apparent wasting of the thoracic muscles, and arrest of development of the whole chest. Many of these disadvantages, however, may be overcome, and of the remainder it may be said that they are more than counterbalanced by the comfort and rest to the diseased part given when the corset is well applied, and by its lightness and cheapness bringing it within the reach of the poorest. Ill applied, however, I have seen it most harmful.

DORSAL REGION.

Turning now to disease in the *dorsal* region of the spine, we find it essentially the same as when occurring higher up, but modified here by the existence of more medullary tissue in the larger vertebral bodies, and by the greater weight to be supported by the column. As regards causation, a history of injury is perhaps more frequently forthcoming than in the case of cervical disease.

Here, too, a diagnosis is easy when the disease is advanced, but by no means so in its earlier stages. The first sign will probably be a cautious gait and dislike to exertion, the patient evincing a desire to lie down whenever possible; at this time

[1] For a more detailed account of them, and of those other contrivances used in the treatment of the various forms of spinal diseases, the reader is referred to Dr. Little's article on Orthopædic Surgery.

there may be a slight, but constant, pain at one part of the column, especially at night, aggravated by rotation or jar to the spine, or on tapping the part with the fingers, but as yet no deformity. Later on, with increased dislike to exertion, the patient will be observed involuntarily to grasp any surrounding objects which might afford support for the upper part of the body, and a little later to rest the hands upon his own thighs with the same object. The respiratory movements of the thorax will now probably become more or less restricted, in order to reduce the play of the ribs against the affected spine as far as possible, and to avoid extension of the latter during inspiration; the breathing will consequently be chiefly diaphragmatic. Other evidence of this disease, when seated in the lower dorsal and lumbar vertebræ, is frequently present in flexion of one or other thigh. This is due to the involuntary contraction of the psoas muscle, whose insertion is involved in the inflammation. This is easy to understand in the case of the lumbar and last dorsal spine, but even with disease of those bones immediately above the latter the same phenomenon may often be noticed, probably because some of the products of inflammation have made their way downwards as far as the insertion of the muscle, but without as yet forming any distinct abscess. The patient, in such a case, will stand with one thigh advanced beyond the other, and the pelvis drooped correspondingly on the same side; there will be slight scoliosis and the body will be bent a little forwards. If told to stand 'at attention' erect, and with the heels well together, he can do so, but will very soon reassume the old position, if left to himself. This irritation of the psoas is often seen very early before any angular curvature exists, and is therefore valuable evidence. It is the first stage of actual psoitis, which is present in almost every case of marked caries of the vertebræ lower down. With psoitis proper the symptoms will be the same as those just given, but more marked; there will be greater flexion of the thigh, and the latter will be more fixed; neither the patient nor surgeon is able to straighten it without much pain being produced, and attempts to bring down the limb only result in the production of marked lordosis, the pelvis rotating downwards and forwards on its transverse axis, and the lumbar spine following it as the thigh comes down straight (see DISEASES OF JOINTS, fig. 77). The position of the thigh in both cases is almost identical with that assumed by the limb in early hip-joint disease, and hence mistakes sometimes arise, unless a very careful examination of both joint and spine be made. Eventually the appearance of angular curvature will, in most cases, clear up the diagnosis. But it should never be forgotten that very marked disease of the vertebræ may exist for a long time without the production of this deformity (see p. 404), and that we must concentrate our attention upon such cases long before it does appear. The curvature itself is not to be treated in the sense of removing it. Attempts to improve it, either by suspension or other extension, are now generally discountenanced.

Abscess in connection with dorsal caries nearly always takes the same course. We find it starting at the front or sides of the vertebræ, and running downwards until it reaches the psoas muscle, on one or both sides,[1] the direction of which it follows in a way to be described in dealing with lumbar caries. Less frequently it passes backwards between or external to the transverse processes, and opens on the back. But this is only found in cases which have been confined for a long time to the recumbent position, and where the disease is extensive. Another ill-effect of confinement to the couch is seen occasionally when the focus of disease is in the lower dorsal region. As the patient lies, the softening spot may be on a higher level than the middle of the dorsal curve. The consequence will then be, as I have seen in more than one case, that the pus, instead of following the course of the psoas downwards away from the spine, and in a direction the least hurtful of any, gravitates towards that part of it usually above, but now the deepest of the dorsal curve, where it lies bathing the bone in a most harmful way, until possibly it makes a passage through the dorsal muscles or spreads under the pleura.[2] Such cases would

[1] Large psoas abscesses on both sides are not common; when they do occur they are generally very unequal as to size. The author, however, has had to treat a case in which a large psoas abscess presented on both sides below Poupart's ligament, showing no difference in size or date of appearance.

[2] In this way I have seen fatal pleurisy produced in more than one case. (See *Trans. Path. Soc.* 1878, p. 191.)

probably have rapidly developed psoas abscesses if placed in the upright position in a corset, and so the diseased part would have been naturally drained. In those cases in which I have seen pus make its way into the pleura, a very considerable attempt had already been made by nature to limit its effusion by the previous production of adhesion all round the thinning spot, but this had been inadequate.[1] The treatment of these abscesses will be considered later in dealing with the question generally.

Another ill effect of extreme dorsal caries may now be briefly considered to which attention has been called of late years by several observers, especially by Dr. Hilton Fagge (see 'Guy's Hosp. Reports,' 1872; also a communication by the author, 'Path. Soc. Trans.' 1880). This is the alteration in the direction and shape of the aorta, produced when a sharp angle is formed in the spine by carious destruction. The vessel is so closely tied in to the column by the intercostal arteries, that it is compelled to follow all the changes of shape of the latter. Hence when abrupt kyphosis exists, the aorta is sometimes acutely flexed upon itself and an actual 'buckling in' of its anterior wall takes place, such as is produced in any elastic tube, when bent sharply. Here, too, the same effect may be noticed in the lumen of the tube—namely, alteration in shape and obstruction. On vertical section of the vessel, the anterior wall appears to form a kind of spur reaching across the diameter of the tube nearly to its posterior wall, or the whole vessel may be, so to speak, wrinkled into coarse folds. The result of this change is believed to be in many cases cardiac hypertrophy, with all its consecutive evils. In one or two cases of angular curvature, I have observed this hypertrophy, but whether as a consequence of change in the shape of the aorta, there was no opportunity of ascertaining, the patients having lived. In another of my cases ('Path. Trans.' vol. xxxii.) the change in the aorta was well seen, but here there was no cardiac hypertrophy. This may have been due to the fact that the case was not of very long standing, the patient being a child. The point is well worth further study in a larger number of cases.

The effect of the change of shape of the spine upon the form of the thorax and abdomen generally finds expression in the hindrance to the functions of the organs contained in these two cavities. For, although the latter do accommodate themselves to their altered relations by degrees, nevertheless, under the altered conditions as to space and pressure, as the thorax falls down upon the abdomen, their vascular supply is always more or less deranged, leading to venous engorgement, &c. Hence patients with marked angular deformity in the lower dorsal region are not only cramped as to the play of inspiration, which is of that short 'grunting' kind so characteristic of the affection, but are also observed often to suffer from various digestive troubles, referable to passive engorgements of the abdominal organs.

The *constitutional* and *local treatment* of the bone-lesion in dorsal disease is based upon principles already considered (p. 410 *et seq.*), and which need no further consideration: a few words only remain regarding suitable apparatuses for mechanical treatment. What is required of any such is that it shall transmit the weight of the upper limbs, head, and thorax directly to the pelvis, without the interposition of the affected spine, and at the same time immobilise the latter. Of the numerous means designed to this end, decided preference is to be given to Prof. Sayre's plaster-of-Paris corset. But, after large experience of its use and post-mortem examination of cases treated by it, which have died from one or other cause, I cannot but think that any endeavour to *correct* the deformity by suspension and application of the jacket is improper practice. What should be aimed at is simply to extend the spine until the weight of parts above is removed from the diseased spot, and any possible spasm of muscles adjacent to the latter is counteracted (as Prof. Sayre believes), and to fix the column thus for long periods. If more than this is done, evil results may follow, and I believe, from post-mortem observation, have followed. It is not that the column at the diseased spot is liable to be torn or loosened by suspension, with damage to the cord or its meninges, or even to the bone-tissue itself. This is prevented by the

[1] Cases, however, are recorded in which adhesion has taken place between the two layers of pleura of sufficient strength to limit the extension of the abscess, so that the latter has made its way into the lungs, and been coughed up, the patient recovering. See Shaw, 2nd ed.

support of the powerful abdominal and dorsal muscles attached to parts above and below the softened spot, which would always take upon themselves any strain not already borne by the transverse and other ligaments still unaffected, or even to the exclusion of the latter from any tension. The dangers which seem most likely to arise from over-suspension are disturbance of the products of the carious process, and consequent increase of irritation, local and general; also stretching of the walls of the small caseous abscesses, so often present in front of the softened bone, this stretching leading possibly even to rupture at one spot or another, with pleuritis or other secondary dangers. I believe I have seen this in a case upon which it fell to my lot afterwards to make a post-mortem examination. As compared with Sayre's corset jacket, the poroplastin appears a very second-rate appliance, and little more than a makeshift. Its use has more than anything originated, perhaps, in the desire to avoid the trouble and loss of time incidental to the application of the plaster-of-Paris corset by the surgeon himself. Taylor's apparatus, too, although undoubtedly useful, in so far as it prevents the spine from falling forward, comes short as compared with the rigid, well-moulded tube of plaster of Paris, in not fully taking the weight off the diseased bones, and in not preventing rotation at the carious focus, as the latter does in a great measure. None of the other numerous older appliances need be considered here; Sayre's corset and some of its modifications have justly superseded them. Personally I regard these modifications as unnecessary as a rule, the original form, if accurately fitted and kept clean, answering all the requirements I am aware of. The use of two undervests, one of which may be removed when worn or soiled, without cutting up the corset, and leaving the other behind, is a suggestion which may be found of value when dealing with very careless or dirty patients.

LUMBAR REGION.

In considering *lumbar* caries, but little has to be added to what we have already studied in cervical and dorsal disease. The conditions are, however, here particularly favourable to the occurrence of myelitis granulosa, the medullary tissue being abundant, and the weight and strain thrown upon each of the vertebræ very great.

Early *diagnosis* is as difficult here as elsewhere, and equally important. The first evidence of the disease noticed will probably be inability to retain long in the upright position, or great fatigue in walking, with a sensation of weight in the limbs, the patient showing great listlessness, dislike to exertion, and a desire to lie down. Some pain and tenderness will probably be felt soon after, on pressure over one or more of the vertebræ behind, and in front through the abdominal walls, and a little later pain on rotating the spine. This is usually most noticed when the patient turns over in bed. The next thing observed now will in many cases be irritation of the psoas muscle, with flexion of one or both thighs, as already described (p. 414). The characteristic gait will then be assumed, the body being bent forwards, and the hands resting upon the thighs, or involuntarily seeking support from surrounding objects. A little later the prominence of one or more spinous processes, with great suffering on movement, will leave no doubt as to the diagnosis.

It is now that *abscess* may be looked for, and it may sometimes be easily recognised, even while still small, by careful palpation. If left untouched, it will present itself in one of the following positions—the region of the psoas muscle, the groin, the loin, or perinæum; it may even pass out of the sciatic notch, and point in the trochanteric region, or fill the hollow of the sacrum, and press upon or burst into the rectum. In some rare cases it spreads in all these directions at once, as shown in a preparation in University College Museum, No. 444. When the pus passes backwards into the loin, it is usually under the force of gravity, owing to the patient having been kept in the recumbent position from the first, also owing to the fact that the pus travels along in the direction of least resistance, *i.e.* along the sheath of the psoas. In other cases it spreads outwards over the front of the quadratus lumborum, and passing over the crest of the ilium, forms a large collection on its dorsum. But in by far the largest proportion of cases the products of lumbar caries sink in the direction of the psoas muscle, where patients have kept their feet for any considerable time

after they commence to form; this is also true of the lower dorsal region. Arrived within the psoas sheath, the pus may form there a very large collection, or rapidly sink farther, reaching the thigh under Poupart's ligament or more rarely pointing above the latter: in extreme cases it may even travel as far as the knee or ankle. Sometimes, but rarely, the pus finds its way from the psoas sheath into the inguinal canal, where it may simulate hernia.[1] Instances again are met in which, in travelling downwards, the pus does not follow the psoas far, but sinking over the brim of the true pelvis, forms a collection in the hollow of the sacrum, which may eventually burst into the small intestine, rectum, or bladder (see Shaw, *loc. cit.*) or through the perinæum. Again, on entering the pelvis the fluid, in other cases, will turn outwards through the sciatic notch, and running along the small rotator muscles, point in the neighbourhood of the trochanter. Here, if the collection be small, difficulties in diagnosis may arise, and it may be mistaken for a suppurating bursa over the trochanter. One particularly interesting case of this nature occurred in the author's practice. A man rapidly developed dorsal caries, and shortly afterwards became paraplegic. At the end of three months spent in bed an abscess formed behind the right trochanter and burst, discharging a large quantity of pus and some fragments of bone. Soon after this the paraplegia disappeared, and when I last saw him he was walking about the picture of health but for the angular curvature.

The special management of these and the other spinal abscesses is considered below.

The *treatment* of the bone-lesion in lumbar caries requires no particular description now (see pp. 410, 411). It need only be remarked that, if the conditions here are very favourable to the occurrence of osteo-myelitis granulosa, for reasons given pp. 401 and 403, the disease is yet easier to treat mechanically in the lumbar region than higher up. Whatever appliance is used, there is more surface above the seat of disease to be grasped by it than in the dorsal or cervical affections, and consequently the inflamed part can be better fixed. A patient with a carefully-fitted plaster corset is well able to walk about and enjoy exercise in many cases, and far more so than where the disease is dorsal, though the corset be equally well applied, and the superincumbent weight upon the affected bone be far less. Another point may be noticed—namely, that it is not necessary to carry the plaster jacket quite so high here as for dorsal disease. Provided it be accurately and firmly planted upon the pelvis, it need not rise quite to the axilla. Again, it should be remembered that, in the opinion of many surgeons, of whom I confess myself one, this corset is unsuitable for infants and very young children. With them the pelvis is as yet so slightly developed, that there is no marked bony outline to be grasped by the lower border of the appliance, whereby the upper part of the body could be steadied, while the latter itself can change shape in many directions, owing to the great mobility of the infant spine. The pelvis consequently slips about inside such a carapace easily, and its only hold is upon the thorax, and that but an imperfect one. There are other reasons too why it is less applicable here than at a later age, such as the difficulty of keeping it dry, the liability there is of chafing the delicate skin of infancy, and the embarrassment, however slight, to the movements of respiration, which would be much more serious at this age than later, for obvious reasons. These conclusions are borne out by personal experience, after a wide use of the corset. I am aware that they are not in harmony with the views of some surgeons fully competent to speak on the point. But I can only say that they have led me to abandon the use of this appliance, for very young children, for some time past.

We turn now to the consideration of the treatment of *abscesses in connection with caries of the vertebræ.*

A few main principles guide us in dealing with these, whether they are due to cervical, dorsal, or lumbar caries. First, they need complete rest, as long as they are small, slow-growing, and beyond reach. Second, if they are steadily increasing

[1] Brodie, *loc. cit.*; Shaw, *System of Surgery*, 2nd ed.

and approaching the surface, they call for evacuation of all their fluid and solid contents, if necessary, with the sharp spoon, if the latter be abundant, as is often the case. Third, efficient drainage of all after products is to be maintained. Fourth, the strictest antiseptic precautions must be observed from beginning to end, *i.e.* from the opening of the collection to the definitive cicatrisation of the drainage opening.

That such abscesses may become absorbed under rest to the spine, and improved general hygiene, we are taught by abundant direct evidence, as well as by analogy. The following is a good illustration of what may take place in this direction. During 1880 I treated a child for lumbar caries. She had been coming backwards and forwards to hospital for some years, at long intervals, and for the last year tolerably regularly, for the application of the plaster corset. No positive diagnosis of psoas abscess had been made, though there was psoitis and marked curvature. The child at last appeared almost cured, as far as the spine was concerned, and had been walking about for a long time, and going to school, when she became suddenly ill, and developed symptoms of tubercular meningitis, of which she died in a few days. A post-mortem examination revealed the fact that a very considerable abscess had, at one time or another, occupied the position of the left psoas muscle. This I now found reduced to a mass of dry, tough, cheesy material, with calcareous plates scattered through it. It was about the size of an adult thumb, and lay as described, running off above as a narrow tract to the focus of disease, and below in another tube narrowing under Poupart's ligament, to swell again into a second small collection of similar material, about the size of the last joint of the thumb. There was hardly a trace of pus anywhere, and yet this dry cheesy mass must have represented a very considerable abscess, which had escaped notice underneath the corset. The preparation of this case will be found in the Museum of University College Hospital. Such cases ought to encourage us to be patient with abscesses of this kind, and to try prolonged rest before evacuation, unless, indeed, we are of those who fear tubercular infection from them.

But when these collections are manifestly increasing rapidly, or are approaching the surface, even slowly, it is well to open them early. Two methods are before us: they may either be aspirated, or opened with the knife, or cautery, as recommended by those who believe in the infective power of strumous pus: the older methods of opening such abscesses, by means of caustics, are not now in favour. The aspirator is, however, not suited to all cases: so long as the contents are fairly fluid, and free from caseous material, or fibrinous shreds, they may be easily and safely evacuated with it. But when, as is often the case with spinal disease, the pus contains much solid matter, the needle is commonly choked with it, long before all the fluid is removed. There are, however, cases where one or two aspirations will suffice for a small collection, which is no longer fed by disease above, in which case any residue may be absorbed. But, with larger abscesses, from caries, it is our common experience that, when they have been emptied once or twice with the aspirator, so much débris has gravitated to the bottom of the sac that the needle is at once blocked on entering, no matter where we puncture. Again, if anything but one of the smallest needles is used, a little of the caseous matter may be drawn into the track of the needle, during the removal of the latter, and may here lead to irritation, resulting in the formation of a fistulous opening of the abscess after some weeks. This I have noticed, even where the parts traversed by the needle were very thick. We have, then, the choice between either leaving the collection to itself or clearing it out through an incision. If the latter line is adopted, we shall notice, at first, an escape of large quantities of curdy matter, followed by thin serous pus. And, if the strictest antiseptic precautions have been employed at the same time, the case may heal, after a shorter or longer period, with only a trifling discharge of serum at each dressing, but no true pus after the first incision. Such a result was extremely rare in the days before rules of absolute cleanliness had been, as it were, formulated by Prof. Lister, even when psoas abscesses were opened by the most skilful surgeons. It was then almost the rule for the flow of the pus to increase a day or two after the abscess had been opened, and to become more and more abundant, while the temperature rose and other signs of fever set in, until, sooner or

later, death resulted from exhaustion or septic mischief. And, even if no septic complication took place, the prolonged suppurative drain eventually led to amyloid disease of internal organs in most cases. Everyone who listened to Sir James Paget's remarks in the discussion on Antiseptic Surgery which took place at St. Thomas's Hospital not long since, must have been struck with his experience on this point, which may be held, from its great extent and varied nature, to be a standard one. He said that he could not recall to his mind any case in which an extensive psoas abscess had either burst of itself, or been opened by the older methods, which had ultimately recovered. All died, within shorter or longer periods, of exhaustion or sepsis. But, though the method of dressing, as at present advised by Prof. Lister in such cases, has such vast advantages over the older modes, its weak points must not be overlooked, if we are to do justice to our patient and to the method itself. The difficulty of retaining the present gauze packing in close contact with the body everywhere for a wide distance round the wound into the psoas abscess is one of these. If the patient be confined to bed, the difficulty is less, especially where elastic bandages are used over all; but, if he get up, and move about, is almost insurmountable with the present form of dressing. This has a great tendency to become caked and matted together to such a degree, during the movements of the limb, that it soon forms little more than a loose shell, under which air has often free access to the part, and to the discharges in the dressing, which then readily putrefy. But confinement to bed for long periods is always undesirable, as we have seen. And yet the most rigid antiseptic treatment must be persisted in for extended periods—namely, as long as open sinuses exist—if we are to exclude imminent risks. And such small sinuses often remain long after the patient might, with advantage, be up and about, with the support of a plaster corset. It remains, then, for the future, to give us a perfectly antiseptic and absorbent dressing, soft and elastic enough to follow all the movements of the parts it embraces, without caking or admitting air and other impurities underneath. In such a dressing a patient with an open psoas abscess might be kept upon his feet, in the enjoyment of fresh air and moderate exercise, with less risk than, with the usual gauze dressing, we are forced to admit exists. The following case illustrates this point :—

A railway porter, aged 29, came to the author at University College Hospital, with marked spinal caries and psoas abscess, of the existence of both of which he was unaware, having been about his work almost up to date. He was treated as an out-patient for several months with the plaster corset and aspiration of the abscess at intervals, as much as 30 and 40 ozs. of fluid being drawn off at a time. Finally as the débris increased in the fundus of the sac, and blocked the needle on each attempt to aspirate, he was admitted as an in-patient, with a view to having all the contents, fluid and solid, evacuated at once by incision under carbolic spray, &c. This was done, and much fibrinous and curdy matter removed. After many weeks in bed the man appeared so much better, that it was thought by the surgeon in charge of the case that he might leave the hospital and become an out-patient again. He was therefore placed once more in a plaster corset, with the usual Listerian dressing applied with every care, and was sent home, the wound being quite aseptic. When, however, he appeared in my department a few days later the dressing was loose, displaced and foul, and the man appeared so ill that I at once readmitted him. The wound was then found by those who dressed him to be distinctly fœtid and infected, and, to be brief, the patient died a few days later of acute septicæmia contracted through it.

In this case, had the gauze dressing done its work during the short time the patient was in his own home (he was a quiet, steady man too), as it had done while in hospital, he would probably have escaped the infection of his wound. Even the quiet walking about there, however, had loosened it, and so permitted access of air to the discharges in the dressing and abscess, with consequent sepsis in its worst form. Most surgeons have seen cases of the same kind.

When these collections have unfortunately opened spontaneously before we see them, it is still well to try every precaution of cleanliness to keep or render them aseptic. Injections of solutions of chloride of zinc are perhaps the most reliable in such cases, with antiseptic packing of medicated wool, jute, or gauze, over the wound to exclude the air and absorb and disinfect the secretions.

Spinal abscesses pointing on the inner surfaces of the body, as, for instance, in the

pharynx or rectum, require less elaborate precautions against septic infection. In the first situation they should (after thorough cleansing of the part with antiseptic gargles) be opened as soon as they produce inconvenience in swallowing or breathing by a *short* vertical incision in the middle line. This will allow the pus to escape slowly and not in a sudden gush, which might carry it into the air-passages and produce suffocation or infective inflammation in the lungs, supposing the patient to escape the first danger. When this opening has fairly drained the abscess, it may be enlarged somewhat for the removal of possible débris. After this cleansing gargles, especially that of chlorate of potash, should be freely used. In the case of an abscess pointing towards the rectum, there need be no hurry in opening it. It is not likely to give rise to any troublesome pressure symptoms, and may usually be allowed to burst of itself. If opened by the surgeon, the rectum should be thoroughly emptied and cleansed beforehand by enemata.

The *prognosis* in cases of spinal disease involves so many considerations that it is difficult to speak definitely on the point. Hereditary predisposition to struma (or, as it will probably for the future be called, to tuberculosis) appears to be the most weighty determining factor. The age at which the disease commences is the next. For, when an affection of the spine begins in very early life, it may, on the one hand, be taken as a sign of the existence of an inherent susceptibility to such morbid processes, and on the other, the general feeble vitality of the tissues at this period renders resistance and repair difficult. The social conditions of our patient have also a strong influence upon our prognosis. Among the well-to-do and wealthy who can command the best hygienic surroundings, and skilled surgical care, deformity, or death, are less likely than among the masses, although scrofula, 'the king's-evil,' is met with amongst high and low. The risks both of deformity and death are increased enormously by neglect of the local and general conditions in their earliest stages, and become imminent when abscess has formed, or, worse, has opened.

SOME UNUSUAL FORMS OF SPINAL CARIES.

Atlo-axial Disease.

Disease of the first two vertebræ requires now some special attention, not only on account of the important structures covered by these bones, and liable to be involved in their injury, but also because it differs in some remarkable respects from that of the other parts of the column.

In the first place, it is apparently a comparatively rare disease now. Thus, for instance, in the ten years 1871–80 inclusive, there is no mention of a single case of atlo-axial disease having been treated in University College Hospital, in the very careful annual reports of the Surgical Registrars, although in these may be found accurate notes of 170 cases, including all the other different forms of spinal caries, with records of all the necropsies performed within that period. Nor do I find a single instance of this affection among the notes now before me of fifty of my own cases of caries of the spine treated as out-patients at University College within the last few years. Again, in the 'Transactions of the Path. Soc.' for twenty-five years, 1849–74 inclusive, the disease has only been brought under notice five times in four of its volumes, only eight cases being presented for consideration.

In former times it would appear to have been noticed more frequently, perhaps because syphilis was allowed then to run on unchecked for longer periods, or was treated too freely with mercury. Thus Rust [1] saw thirteen cases himself (among which he had an opportunity of performing nine necropsies), and other of the older authors appear to have been more familiar with the disease than we are at present.

Again, it differs from the commoner forms of disease in being met with in adult life in a large proportion of instances. Thus, in twenty-four cases I have been able to collect, in which the age is indicated, only six were under twenty years of age (and two of these had reached eighteen) before the disease had manifested itself, while

[1] *Arthro-Kakologie*, 1817, p. 76.

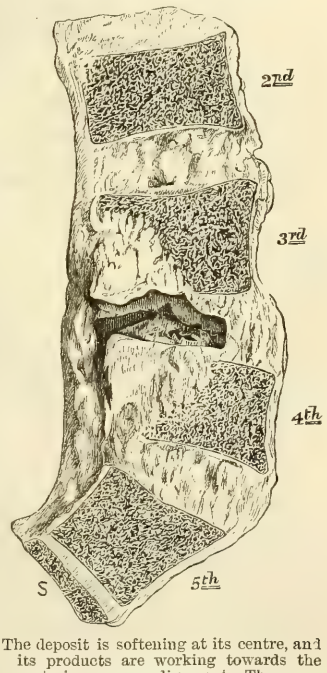
eighteen were adults. Indeed, it may develop in the aged, as is shown by a very remarkable case recorded by Dr. Ogle,[1] where the patient (a very reverend ecclesiastic) had reached the age of 73 before the process began. Further, commencing thus in the adult, the causes of origin are apparently different from those operating in the commoner forms of spinal disease. Then it appears in many cases much more distinctly traceable to injury, and to occur thus in persons, to all appearance, in good health, without any scrofulous tendencies. Then it appears capable here of advancing very rapidly in destructive change, and, under treatment, of repairing itself as rapidly and perfectly.[2] Again, the process is more manifestly due here than lower down, in some instances, to syphilis,[3] or the abuse of mercury for the cure of the latter,[4] this syphilitic disease starting in the pharynx or in the vertebræ themselves. Finally, the process itself seems to affect the joint-surfaces of these bones more frequently than the anterior segment. These are all points which offer a contrast to the forms of disease usually met with lower down the column. And, in studying these diseases and the records of cases observed by others, the suspicion is almost forced upon one that syphilis is much more frequently a cause of spinal caries in the adult than is commonly supposed,[5] and that this is especially true of the atlo-axial form.

The latter form of disease is not so common that one can draw very positive deductions from the published cases. Thus Lawrence states that 'it was hardly mentioned by English writers in his time, while by most it was almost completely ignored.' But such records as are published can hardly be read carefully without suggesting, at all events, the above conclusion.

That *syphilitic* deposits can give rise to spinal caries of the most palpable kind, without the syphilitic characteristics of the lesion being lost or masked, the following case amply shows. It may be cited here with advantage, although the part affected was not high up in the column. The very close attention which is now being given to syphilitic lesions in all the tissues of the body can hardly fail before long to show us how far such cases have a bearing upon the whole question of caries of the spine.

A man, æt. 56, tall and well developed, but in very bad health, was admitted into the Hôpital St. Louis, in July, 1876, under the care of Professor Fournier. He had been losing health for some time, and suffering from pains in the loins and lower limbs. Examination showed marked evidence of syphilis of long standing, *e.g.* syphilitic sarcocele, ten cutaneous gummata, as also in the muscles, and a gummous ulceration of the great toe, also a macula on the thigh. In spite of treatment, this man's condition soon became worse and worse, and he died in October, 1876.[6]

FIG. 89. — Vertical Antero-posterior section of Lumbar Spines, showing deposit of gumma in the back part of the third and fourth. (After Fournier.)



The deposit is softening at its centre, and its products are working towards the posterior common ligament. There was also gummatous deposit in the roots of the nerves given off here.

At the necropsy, the syphilitic nature of the lesions alluded to was proved, and others were found, *e.g.* characteristic cicatrices on the spleen, gumma of the fourth lumbar nerve, 'lastly multiple and considerable lesions of Pott's Disease, affecting the lumbar

[1] *Path. Soc. Trans.* vol. xv. p. 16. [2] Hilton, *On Rest and Pain*, 2nd ed. p. 93.
[3] Wade, *Med.-Chir. Trans.* vol. xxxii. p. 65; Beck, *Dub. Journ. of Med. Science*, 1877, p. 189.
[4] Keate, *Lond. Med. Gaz.* 1835, p. 13.
[5] While this article is going to press, I find that the same idea as to the probably frequent syphilitic origin of spinal caries, when it occurs late in life, has struck Mr. Furneaux Jordan from observation of cases. (See *Med. Times and Gazette*, March, 1867.)
[6] Fournier, *Annal. de Dermat. et de Syph.* Jan. 1881.

column, especially the third, fourth, and fifth vertebræ of that region.' These consisted of ' denudations of bones, thickening or destruction of the periosteal and ligamentous structures, sclerosing osteitis with caseous and purulent infiltration, almost complete destruction of the intervertebral fibro-cartilage, and a vast hollow mass in the lumbar column, also an abscess in each psoas muscle, &c. &c.' The state of the vertebræ is well shown in fig. 89.

A careful microscopic examination showed the deposit in these bones to be clearly gumma in various stages of degeneration; also that there were many gummatous nodules in the nerves passing off from this region. In fig. 89 it may be noticed, as in fig. 84, that the disease lies on the posterior aspect of the bodies where any injury would be most unlikely to affect the bone. Nor was there any history of injury in either case, or any reason to suppose that such had taken place. The disease had

Fig. 90.

The girl, aged 15, from whom the drawing was taken, had continued in her situation as a domestic servant till three weeks before her admission into the hospital; at which time the neck was distorted as represented in the figure. The disease had apparently commenced four months previously; but it had caused so little pain or inconvenience, that she had not been obliged to give up her work during its progress. She complained of pain darting from the swelling in the neck upward to the crown of the head, and downward over the shoulders, and along the arms. She had also slight incontinence of urine. The most prominent part of the swelling in the neck was formed by the spinous process of the axis; above which, and between it and the occiput, a distinct hollow could be felt. Chiefly by rest and counter-irritants, she improved so much that in six weeks she was discharged. But three weeks afterwards, she was readmitted on account of an aggravation of the former symptoms, and there being a weakness of the lower extremities, which caused them to sink under her when she attempted to walk. In a month she was sufficiently recovered to be sent to a convalescent hospital at the seaside. She subsequently called various times at the hospital, to show that she had regained her strength completely. A cast from the neck is in the Museum of the Middlesex Hospital.

manifestly originated in both instances in the breaking down of a special deposit infiltrating the osseous tissue of the part.

The *symptoms* of atlo-axial disease, upon which we have to rely in the earlier stages, are purely subjective. These require to be borne carefully in mind; for if anything is to be done for the complaint, it must be done early. Probably the best description of these symptoms extant is that of Rust (*l.c.* §12). The perusal of the original, upon which I draw largely, in the following lines, will amply repay the student.

The first evidence of the affection will be pain in the neck, especially at night. This is aggravated by bad weather, by swallowing large morsels, and by deep

inspiration. At this time there may be no trace of anything objective, either in the pharynx or externally, and the condition may therefore be easily mistaken for rheumatism. Many patients refer all their pain to the neighbourhood of the larynx. A little later, the movements of the head become painful, especially lateral flexion towards one or other shoulder. This pain, too, is referred often to the larynx (sometimes the scapula), and is described as stretching or tearing on one side. A careful examination with the finger pressed down upon the first two vertebræ will now probably discover an acute tenderness, though there is still no external sign of disease.

From this on the affection usually progresses rapidly if left alone. In addition to great aggravation of the subjective symptoms alluded to, especially pain in the occipital region on movement and on pressure, leading to fixation of the whole neck, the head will begin to sink forwards and usually a little towards one shoulder (fig. 90). This may be towards the side least affected, and is due probably to the desire of the patient to relieve the diseased side from the weight of the head. But Rust gives a different explanation in alluding to the fact that in nine autopsies he had found the left side of the bone most diseased in seven cases, the right only in two. If both sides are equally affected, the head simply drops forwards. Soon after this a peculiar fulness will be noticed in the middle line behind, just under the occipital bone, in which the spinous process of the axis, not usually felt, is now apparent. This is due in part to the shifting forwards of the head, and in part to inflammatory œdema. Anxiety in the patient's expression of face is now very manifest, especially when the slightest movement of the body is called for, when it becomes necessary to fix the head, not only by its proper muscles, but even in many cases with the hands placed on both sides. If the disease now progress further, the head glides slowly forwards on the atlas, until sooner or later the medulla oblongata is compressed by the odontoid process of the axis, partial or complete paralysis resulting in many cases. Again, pus may collect in front of the dura mater of the cord, and so produce compression (Wigan's case, quoted by Lawrence); or meningitis may be set up either with the cranium or canal. Again, the diseased ligaments of the odontoid, or the latter itself, suddenly giving way during some slight increase of strain, the process may fall backwards and compresses the cord, producing instantaneous death (Powell; Hilton, *l.c.*) These are the chief dangers to be dreaded, but by treating the cases early they can be averted. It is remarkable, however, to what an extent the cord may be compressed here without any damage to its functions, and also how completely these may be restored after having been for a long time almost entirely suspended. This is plainly shown by several of the cases alluded to. The extent, too, to which the canal may be reduced in its antero-posterior diameter without suspending life is almost incredible, until we examine such specimens as those exhibited by Sir J. Paget and Mr. Shaw,[1] where the odontoid had approached within two lines in one, and $\frac{3}{10}$ of an inch in the other of the posterior wall of the canal (fig. 92).

As to the peculiar conditions of the cord, produced by pressure or inflammation, and the constitutional conditions to which they give rise, they need not be alluded to here, as they are treated of in the article on Injuries of the Spine, and are alluded to as far as necessary at pp. 409 *et seq.*

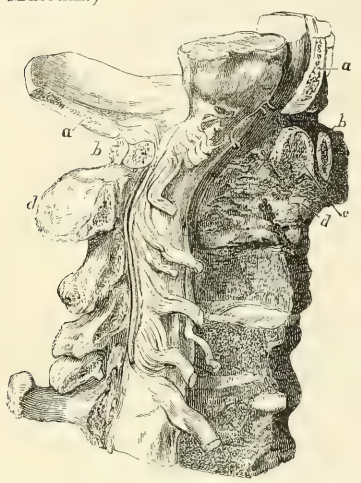
The *treatment* of atlo-axial disease is conducted upon the principles which guide us elsewhere. Rest for the part is our great aim, and may be secured by placing the patient in the recumbent position with sand-bags at either side of the head to steady it (Hilton), and prevent any of the untoward accidents of displacement, or the use of Sayre's Plaster of Paris Corset and Jury Mast. This latter plan has the advantage of admitting of exercise of the body while relieving the diseased bones of the weight of the head. As to internal remedies, those already alluded to (p. 410) are called for. But, in addition to these, it is probably desirable to resort to the cautious use of mercury in the case of young adults, even though there be no direct evidence of the disease being due to syphilis. But where there is any history of this, either mercury

[1] *Med.-Chi. Trans.* vol. xxxi. p. 289.

or iodide of potassium should be used for a time, the latter preferably in older individuals and asthenic cases, and combined with tonics and cod-liver oil.

The *prognosis* with this disease is not now considered so grave as was formerly the case. Thus Rust, and others of his day, regarded it as almost inevitably fatal, while since his time many instances of recovery, as proved by careful examination,

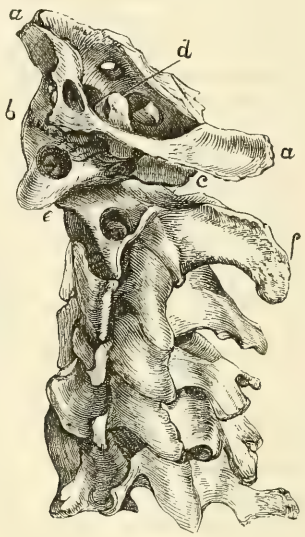
FIG. 91.—Atlo-axial Disease. (Figure from specimen in Middlesex Hospital Museum.)



a, *a*, portion of occipital bone, in proper relation to atlas; *b*, *b*, section of atlas. From destruction of the ligaments of the atlo-axial articulations, the atlas has slid forward, borne by the weight of the head, and has carried the odontoid process of the axis with it; *c*, odontoid process of axis: loosened at its base by disease, it has been carried forward in connection with the atlas; *d*, *d*, section of axis: its odontoid process detached: its articulations with the atlas, and with the body of third vertebra, and its body, all much diseased; the great projection backward of the spinous process in reference to the occiput and atlas, is a result of the gliding forward of the latter. Within its canal the spinal cord is seen bent at an obtuse angle, the consequence of the portion contained in the foramen magnum and atlas being carried forward, while that in the axis has been stationary.

Case—The patient, a butler, past the middle age, and corpulent, had for some time stiffness in the neck, with pains in the head and arms, supposed to be rheumatic. When seen by the writer, a large swelling extended from the upper third of the neck behind, to the highest part of the occiput, concealing the forms of all the bones which it covered, except the spinous process of the axis, which appeared unduly prominent. He could perform the nodding, but not the rotating motion, of the neck. The vertical axis of the head was advanced perceptibly too far forward, in comparison with the vertical axis of the neck; the effect apparently of the head having been transported to the front slightly beyond its proper plane in relation to the spine. The disease was seen to be atlo-axial; and he was removed to the hospital. Progressive paraplegia soon commenced, and it proceeded downward; first, one arm became weak and then paralysed; shortly afterwards, the other also became weak and then paralysed; and the lower extremities followed the same successive course. But before the legs were totally paralysed, he died; his death having been accelerated by a severe attack of bronchitis.

FIG. 92.



The specimen from which this figure was taken was removed from the body of a man found dead in the streets. There was fracture at the base of the skull, all round and at a short distance from the foramen magnum; the boundaries of the fracture being seen in the figure. *a*, *a*, portion of occipital bone, insulated by the fracture; *b*, anterior tubercle, on anterior arch of atlas; *c*, posterior tubercle, on posterior arch of axis; *d*, odontoid process of axis. Its situation corresponds nearly to the centre of the vertebral canal, at the level of the foramen magnum and atlas; *e*, body of spinous process of axis. About three-fifths of the articulating surfaces of the atlas have been displaced forward on the corresponding surfaces of this bone, thereby accounting for the projection anteriorly of the front segment of the atlas; *f*, spinous process of axis. The posterior segment of the ring of the atlas crosses the canal of the axis nearly in its middle. The distance between the posterior surface of the odontoid process, and anterior surface of the posterior arch of the atlas (the antero-posterior diameter of the vertebral canal), measures from a third to a quarter of an inch; that between the odontoid process and the anterior arch of the atlas, at the original sites of their articular facets, is five-eighths of an inch. The space between these points is traversed by an irregularly cylindrical beam of bone which unites the two surfaces: this new growth of bone is not visible in the drawing, but it had obviously been formed during the process of displacement of the atlas upon the axis, and attests the slow rate at which it had taken place. For a more detailed description of the specimen, accompanied with a drawing representing it in a different view, see 'Med.-Chir. Trans.' vol. xxxi. p. 289.

and clinical post-mortem, have been placed on record by the most competent observers (Hilton's, Paget's, Shaw's, Wood's, Keate's, Wade's cases, *l.c.*) The whole question turns upon the possibility of recognising the nature of the case very early, and then securing rest for the head and diseased bones, while the patient's hygienic surroundings are rendered as good as possible. With these conditions recovery will usually take place, especially among adults, but of course with anchylosis of the diseased bones.

Sometimes large portions of the latter are necrosed and cast off through the pharyngeal wall, but this need not necessarily interfere with perfect recovery. This is well illustrated by the cases of Mr. Wade and Mr. Keate, in both of which a large portion of the atlas, including its articular facet for the odontoid process, came away through the posterior wall of the pharynx. In the last case 'the lower surface of the basilar process, including the lunated border of the foramen,' was also exfoliated a month later. Both these cases recovered their former health subsequently, but it must be noted that the disease in both these instances was manifestly due to syphilis, either of the pharynx or bone itself, or to the abuse of mercury employed for its cure.

Among the unusual forms of spinal disease may be mentioned, finally, one in which we are unable to discover anything objective to account for the very severe subjective symptoms present. This is, that intense pain in one or other part of the spinal column occasionally complained of, for which the most careful examination into the patient's history, and the actual condition of the part itself, fails to discover any cause. This is what was described by Sir B. Brodie and older writers under the name of 'hysterical neuralgia,' seeing that it had been noticed more frequently among females with hysterical tendencies than among any other class of patients. But more extended study will probably show that, like the 'nervous mimicries' of disease in other parts of the body, this in the spine is by no means confined to females, but is met among the neurotic of both sexes.

Referring the reader for general consideration of nervous mimicry to the paragraph devoted to it in the essay on Diseases of Joints, it is only necessary to briefly point out some few points regarding mimic disease of the spine, and how it differs from the real affection.

Intense pain is sometimes complained of at one particular spot in the column, usually near one of the spinous processes, whether cervical, dorsal, or lumbar. It is keen and boring, as though a nail were being driven into the part. It is usually referred to some violence, but, on inquiry, there may be no clear history of any injury adequate to produce real disease. The patient will assert that this pain is constant, is much aggravated by pressure or movement, and, to avoid all suffering, will lie for long periods confined to bed.

Such cases call for the utmost care and study, lest true disease of the spine in its earliest, and therefore most manageable, stage should be overlooked.

Attention to the following points will be of most value in coming to a conclusion.

There is usually a history of injury, but, if inquired into, it is found to be quite inadequate to produce a condition such as that complained of. The column is not rigid at the spot complained of, as would be the case even with the earliest inflammatory affections. And, although the sufferers will state that the pain is greatly increased on movement, still they will usually wince or writhe when the seat of pain is handled in a way which shows clearly that this is not the case, and that the movements here are as free as at any other part of the column. The increase of suffering, too, complained of on gentle pressure on the spot, is out of all proportion to what is felt in cases of real disease. Again, if the patient's attention be fully engaged on something else during the examination of the part by pressure or rotation of the trunk, it will be noticed usually that both can be pushed to an extreme degree, without eliciting much expression of suffering. Then, when left to themselves, these patients, when unnoticed, will turn in bed, sit up, or flex the spine with an ease which one with true structural disease would never exhibit.

Sometimes this condition is complicated with hysterical paraplegia, giving the case, at first sight, a grave aspect. But, knowing that in the vast majority of cases paraplegia with true caries does not come on until great destruction of the column has taken place, with consequent deformity, we are reassured in such cases by the absence of the latter. The purely medical features of the case, too, will help us materially to a correct diagnosis.

Arthur E. Barker.

DISEASES OF THE SPINE.

PART II.

SCOLIOSIS, OR LATERAL CURVATURE.

THE above titles are given to a distorsion of the chest properly, which originates in twisting of the spine. The term 'Scoliosis' (σκολιός, tortuous) has the merit of brevity, and is largely used on the Continent.

The degree of deformity of the chest, shoulders, hips, or trunk in general, caused by the combined incurvation and twisting of the spine, is, in many cases, extremely great. Patients in whom the distortion is taking place, although often weakly, do not suffer at the outset from any serious illness. An important distinction is to be drawn in regard to the causes producing them, between it and angular deformity of the spine from caries, and between them both and curvature of the bones generally, including the spine, from rickets.[1]

The progress which scoliosis makes at first, in correspondence with the youthfulness of the patient, is commonly rapid; in proportion as the bones become more consolidated with increasing years, it is slower; and at about seventeen, when the skeleton has nearly reached maturity, it may become for some time stationary, and not unfrequently aggravated in later life.

A distinguishing characteristic of scoliosis is that it is incomparably more frequent in girls than boys.

Moreover, it is met with among the daughters of the well-to-do in tenfold greater numbers than in those of the poor.

Often an hereditary predisposition has been made out; hence arises a question whether it may not often be hereditary, when no history of it is obtainable, especially as Guérin [2] has recently, from his dissections of congenitally affected infants, pointed out that the direction and sides of the curves are often the same as in adolescent non-congenital cases.

The chief peculiarity in the construction of the vertebral column which favours incurvation is that, although its chief office is to support the superincumbent weight, it is at the same time flexible. Again, this many-jointed pillar, instead of resting on a fixed foundation, is reared upon one which is constantly changing its level. The pelvis, upon which the spine is erected, is poised on the globular heads of the thigh-bones, and it rolls and pitches at various angles according to the positions of the limbs. The column is, therefore, in the predisposed, subject to be deflected from the perpendicular at each shifting of the base, when the weight it sustains will be thrown unequally on its articular surfaces.

The spine, at the age when it usually commences, has attained nearly its full length. That forwardness is in conformity with the development of the cord within, for the slight addition to the column which takes place later is made at the base alone; that is, below the level of the cord itself, and in the region of the 'cauda equina.' The subsequent increase in the general height is chiefly owing to the elongation of the lower extremities. But, although thus advanced in length, the ossification of the spine has not made equal progress. The cartilage is in disproportionately

[1] See Part I; also article Rickets, vol. iii.

[2] *Œuvres de Jules Guérin*, 1 livr. 1880.

large quantity compared with bone. The epiphyses on the upper and under surfaces of the bodies consist chiefly of cartilage. The texture of the bodies themselves is porous and spongy, and their surfaces in relation with the epiphyses, instead of being flat, are partly convex and rounded as in infancy; the pedicles, laminæ, and processes of the posterior segments of the vertebræ, besides being deficient in density, are imperfectly moulded in shape; and the borders of the articular facets of the oblique processes, instead of consisting of bone, are edged with cartilage.[1]

The muscles which elevate the spine are distinguished both for their great number and the variety of the directions and movements in which they severally act. These provide for the prompt adjustment of the superincumbent weight to the centre of gravity, in the numerous deviations of the spine from the straight line in the ordinary motions of the frame. It may be added that these muscles are inserted into the vertebræ close to their centres of motion; they therefore act upon them at a mechanical disadvantage; but the power thus lost is amply compensated for by the assistance which they derive from the elasticity of the column.

For keeping the spine in a state of average strength, it is necessary that a proper amount of varied exercise should be allowed. But in the case of young females of the class of society in which this curvature is most common, certain circumstances tend to prevent them from obtaining it. The age at which the deformity commences coincides with that at which a notable change takes place both in the physical and moral constitution of a female. As the period of puberty approaches, a girl begins to show tokens of her feminine character. Having been previously, like her brothers, full of animal spirits and fond of romping games, she spontaneously takes to sedentary occupations. The time given to learning and accomplishments is disproportionately great compared to that allotted to the bodily graces and preserving the health. In some instances, however, parents have insisted that the girl had continued to be a regular 'tom-boy.' Were these instances hereditary?

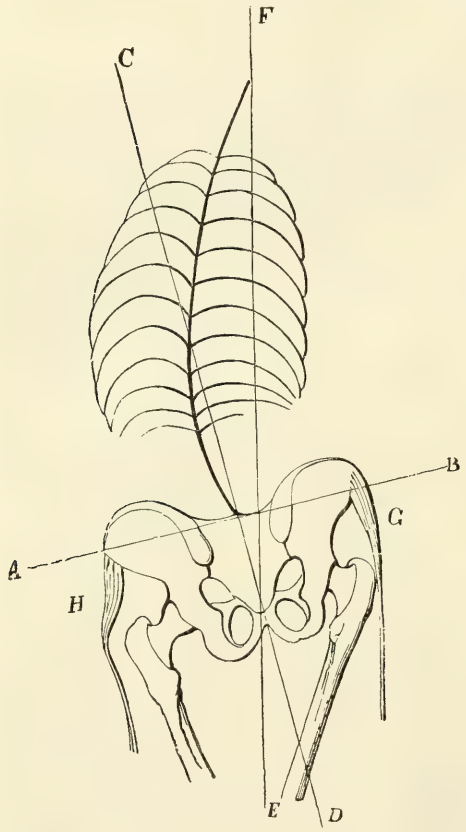
When the muscles lose power, the loss is felt beyond their own sphere. It is a law of the animal economy that an intimate relation should exist between the muscles which originate force and the bones and joints which bear the brunt of it. The mutual connection may be illustrated by the case of the trained boxer. In proportion as the power of his muscles increases, the density of the bones and tenacity of the ligaments are augmented. Were it otherwise, and the muscles of the arms acquire great strength, while the humerus and the ligaments of the elbow, for example, were relatively weak, he would be in danger of fracturing the one or dislocating the other when he inflicted a heavy blow with his fist on his adversary's head. And the converse is equally true; in proportion as the muscles diminish in power, the bones become less solid, and the ligaments less capable of resistance. Applying the law to the state of the bones and joints of the spine, it will be seen that when the muscles have been debilitated by inaction, a corresponding degeneration of the internal structure of the vertebræ and of the ligaments will ensue.

On viewing the mechanism by which the apparently inconsistent qualities of stability and mobility are combined in the spine, it will be observed that the vertebræ rest and move upon each other only at three distinct surfaces of contact, above and below respectively. These are, anteriorly, the fibro-cartilaginous articulations of the bodies; and, latero-posteriorly, the articulations of the wedge-shaped, oblique, or articular processes. When the spine is straight, the pressure of the superincumbent weight will be divided equally among those surfaces; and no damage need be apprehended. But it will be otherwise when the column is inclined to either side, and is allowed to remain curved. The effect which will be produced on the concave side of the curve will differ from that produced on the convex; but both will tend, each in its own way, to render the bend a permanent one. When the spine yields on one side, it is obvious that the weight of the body will fall exclusively on the articulations situated on the side on which it yields, and that a convergence of the adjoining

[1] Two preparations of the spine, preserved in spirits, showing the extent of ossification of its different parts at the age when lateral curvature commences, are contained in the Museum of the Middlesex Hospital.

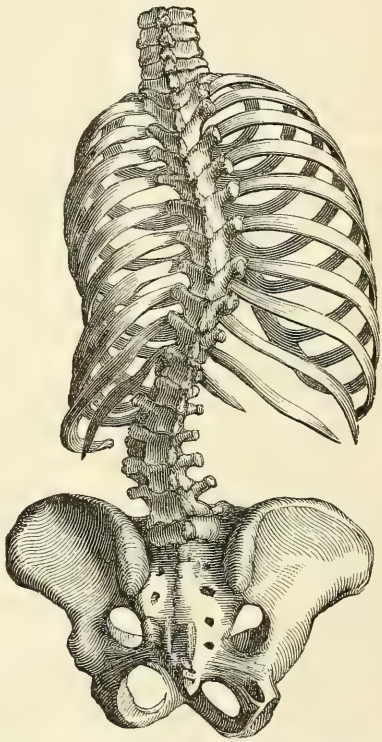
structures will take place; hence the force acting on this, the concave side, will be one of compression. Again, it is obvious that the effect of the inclination on the articulations of the convex side will be that of separating the surfaces, and producing a divergence of the connecting structures: accordingly, the force here will be one of stretching and elongation. Now it is important for our subject to observe the changes which will be produced in the articulations by the operation of these distinct forces. By the compression acting on the concave side, there will be, as the first change, a tendency of the surfaces to glide past each other beyond normal bounds, in a

FIG. 93.—Unpublished diagram of Mr. A. Shaw, intended to illustrate the effect of resting mainly on the right leg—the normally stronger leg.



G, tensor vaginæ femoris; H, the same muscle in a state of relaxation; A, the left ilium lowered; B, the right ilium raised; C D, line of corresponding tendency of spinal column; F E, line towards which the trunk is instinctively inclined in order to obviate the tendency of C towards the ground. The dark curved line which springs from the junction of the lines C A B represents below the ordinary lumbar curve to the left, and above the direction of the dorsal region to the right, in order to recover the centre of gravity.

FIG. 94.—Back view of average severe Scoliosis.



[From Mr. Alexander Shaw's original dissections and drawings. They represent the stage at which the greater number of cases of 'lateral curvature' are first brought for consultation, as said to have been recently discovered by the parents, but which, doubtless, as a rule have already been two or more years making insidious progress. It may be remarked of this distortion, as of some others, that it often makes an alarming sudden progress after two or three months of some exhausting pursuits, such as long daily rides on horseback, over-long walks, and standing during an autumnal vacation, or the too early permitted indulgence in late hours, at the age of accelerated growth, and of approaching puberty, when any fresh natural risks of disturbance in the economy should be guarded against.]

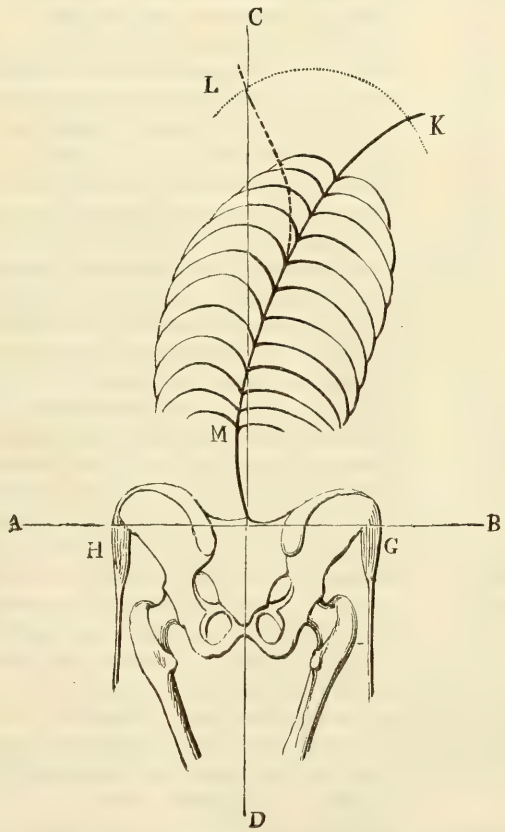
downward or converging direction; and subsequently the bony structures will come into contact and undergo absorption. By the force of dilatation, acting on the convex side, the ligaments will be overstretched in an eccentric or expanding direction. Meanwhile the bony surfaces enlarge on the convex side when relieved from the normal pressure, through continuance of growth, thus adapting themselves to the change of relation, in a manner similar to that which we have described as taking place in club-foot under similar circumstances. The general result will be that the vertebræ included in the curve will receive a bias to incline sideways, first, from the

weakness of their articulations, and next, from the unequal changes in their bony surfaces and processss. And such, it may be added, constitutes the starting-point of organic mischief.

General appearances.—The deformity varies as to degree and relative place in the spine; but a typical form can be recognised in all cases, proving their identity in origin and kind. According to it, two curvatures coexist; one above the other, and one balancing or opposing the other; so that together they describe a serpentine line, like the italic letter *f*. The superior curve is situated more or less high in the dorsal region; the inferior occupies the lumbar. (See figs. 94 and 95).

In general the curvatures just mentioned are the only ones. But, if the dorsal be lower than usual, a curve in an opposite direction, formed of upper dorsal and

FIG. 96.—Illustrative of the gradual production of the permanent compensatory Dorsal curve, simultaneously with the Lumbar curve.



The patient is supposed to be walking in a straight direction, or seated on an even seat, the line of the pelvis A B being horizontal. A curve having been established at M, the head, if the spine were rigid, would fall to K. It is instinctively swayed to L, thereby causing the dorsal curve. Compare fig. 94.

FIG. 95 represents an average case of Scoliosis, or rotatory lateral, or what is commonly called lateral, curvature of the spine (from a photograph).

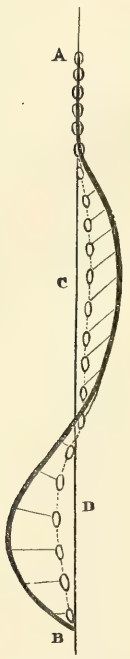
lower cervical vertebræ, will probably be found. Again, in the sacrum, a slight diminution of breath on one side may represent the presence of a curve there, the counterpart of that above in the lumbar region.

The course which the different curves follow, in reference to the sides of the body towards which they respectively bend, is so uniformly the same in a large majority of cases, that it appears governed by a general law. Thus, looking first to the lumbar curve, experience shows that, in about nine patients out of ten, the column is deflected from its base to the left side, and that it is then inclined to the right; thereby forming an arc, the concavity of which is on the right. As to the dorsal

curve, the direction it takes is determined by that of its fellow; for, as the one is placed counter to the other, the arc it describes will be concave on the left. In those exceptional cases in which the above rule is reversed, the concavity of the lower looks to the left, and that of the higher to the right.

But the curvatures do not consist simply of lateral archings of the spine. Combined with each curve to either side, there is a vertical twist in the column, consequent on a partial rotation of the vertebræ on their long axis. And the direction of the contortion in reference to the curve is constantly the same; that is, the revolution of the vertebræ is always such, that their sides corresponding to the concavity are wheeled forward, and those on the convex side backward. It follows that, as the spine is bent laterally, and also contorted longitudinally in the upper curve, and is also similarly bent and rotated in the lower, but in a contrary direction, a spiral or corkscrew condition will be produced; or the column will present an appearance not unlike what might be supposed to result from taking it, when soft, at both ends, and twisting it between the two hands as a washer-woman wrings a wet cloth.

Fig. 97.



In this schematic figure of a scoliotic spine, Mr. A. Shaw exhibits at a glance the greater straightness of the spinous processes than of the bodies.

Mr. Alexander Shaw, the author of the article on this curvature in the former editions of this work, to whom science and ourselves are much indebted for his accurate and original researches, was the first, we believe, to point out that, in estimating the amount of distortion, the surgeon should not be guided by the degree of departure from the perpendicular line of the tips of the spinous processes, as he explicitly says in the succeeding paragraph:—

'Here it may be convenient to notice a source of deception connected with the contortion, to be guarded against in examining a young person's spine for the detection of lateral curvature. The ordinary way of proceeding is for the surgeon to run his finger down the ridge of spinous processes, and by dotting the tip of each in its turn with ink, obtain a line representing the curves. To prove the fallacy of the method the adjoining diagram is introduced. The bold, outer, curved line is intended to show the course of the bodies of the vertebræ; the faint dotted one that of the apices of the spinous processes. It will be seen that the combined effect of the twofold incurvations and contortions in the dorsal and lumbar regions is to make the tips of the spinous processes, above and below, range themselves into a line which is nearly straight. That result is owing, first, to the fact which has been stated—that in the contortion accompanying each curve, the spinous processes point toward the concave side; and, secondly, to the concave aspects of both curves, upper and lower, being turned in common to the median line of the body. It follows, of course, from the apices of the processes in each equally approaching the median line, that the joint curvature which they describe will deviate but slightly from a straight line.'

Formation of the curvatures.—Anatomical reasons point to the probability that the lumbar curve is first formed. 1. The vertebræ of that region, being situated at the bottom of the column, have the whole superincumbent weight accumulated on them. 2. This part of the spine is highly flexible, decidedly more so than the dorsal. 3. Owing to the unstable character of the base—the pelvis—on which the lumbar vertebræ rest, they are more prone than others to be deflected from the perpendicular. 4. The lumbar, unlike the dorsal vertebræ, derive no support from the clavicle, sternum, and the ribs. On the contrary, the bodies of the lumbar vertebræ have only such support in front as may be afforded by the abdominal muscles, and the intervening, more or less, soft and yielding viscera. In the healthy and robust, accustomed to due physiological activity, the tonicity of these muscles, and the due robustness of fibrous and osseous structures, oppose anterior and lateral yielding of the bodies.

The question may therefore be asked, If there be any particular position into which the lumbar vertebræ are liable to be habitually placed which might expose them to become permanently curved? Now, there is a particular posture into which persons have an instinctive tendency to place themselves for the sake of getting relief when fatigued in their lower limbs, either from walking or standing; and while indulged in, the spine is bent laterally at the loins. The attitude is known in the drill of soldiers as the position of 'standing at ease.' And a special mechanism is introduced into the human frame in connection with it. The part of chief consequence in the apparatus is that strong membranous web which covers the muscles on the outside of the thigh as a sheath, and is called 'fascia lata.' This dense structure is attached extensively above to the external lip of the crest of the ilium, and is continued below into a similar fascia on the outside of the leg. The way in which the mechanism acts is as follows :—The foot of the person having been solidly fixed on the ground, with the knee extended, the pelvis, carrying the body with it, is allowed to drop into an oblique position to the opposite side. The consequence of this inclination is, that the side of the pelvis which corresponds to the leg on which the person stands is elevated. But a further result ensues: the elevation of the crest of the ilium, to which the fascia lata is attached, causes that membrane to be put into a state of tension. In other words, the expanded membrane acts the part of a ligament in restraining the pelvis from falling too far sideways; it therefore, in effect, supports the weight of the body. It may be added that, owing to the same lateral inclination of the pelvis, the head and neck of the femur are drawn outwardly from the acetabulum to the extent of putting the capsular and round ligaments on the stretch; they will therefore assist in locking the hip-joint, and fixing the pelvis. In that manner, the task of keeping the body upright is thrown off the muscles and given up to fibrous or ligamentous parts; and it follows that, as these structures are devoid of sensation, they can perform the duty without fatigue.

But what is of greatest interest in connection with the attitude is the curvature in the spine required for preserving the equilibrium. The appearance of that deviation will be best seen by observing a young person whose joints are flexible, lounging lazily on one leg. A large sweeping curve, sometimes almost a semicircle, will be found extending from the lower part of the dorsal region to the sacrum. Now, if it be admitted that the posture is one of ease, which gives relief to the muscles of the limbs when fatigued, and is, moreover, frequently indulged in, it may be granted that the curve will be prone, in a young, growing person, especially of delicate frame, to become permanent. The vertebræ, and all the structures connecting them, will be in danger of undergoing changes in their forms and relations, to accommodate themselves to the position. Supposing, therefore, that the curvature has become confirmed, and that it is situated principally in the loins, what effects may be anticipated?

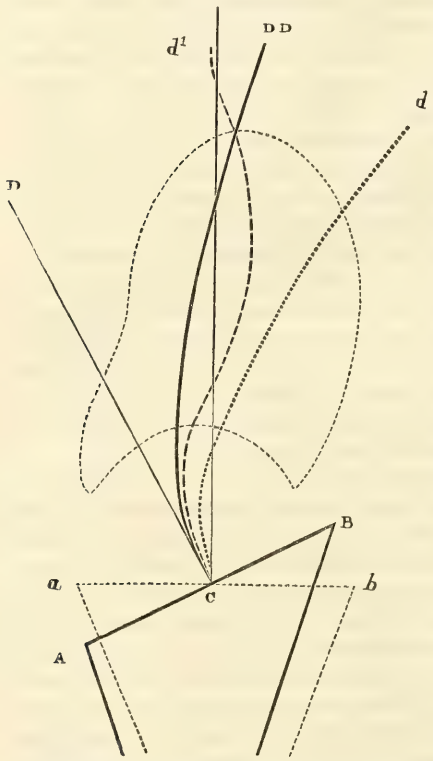
It is obvious that, so long as the person in whom the curve exists can keep the pelvis poised in its oblique position, he will experience no inconvenience because the deviation is adapted to it. But the circumstances will be greatly changed when he adopts a posture in which the pelvis is necessarily horizontal. That is the case in sitting or in walking. It may therefore be expected that when a person in whom the spine has acquired a permanent bend near the base sits or walks, not only the column, but the whole superstructure reared upon it, will fall extensively to one side.

There will be remarked in most cases of advanced scoliosis more or less marked tendency to a third or cervical curve. The dotted line c d^1 (fig. 98), if continued slightly upwards and across the median line, will represent this third curve. The tendency to the third curve is shown in the living, by the head slightly leaning to one side, and being at the same time slightly rotated.

It might, perhaps, be thought that this habitual lumbar curve could be rectified by the patient exerting the muscles of the back to prop up the spine, or by poising the pelvis in a contrary line to the first. But these attempts will be unavailing for two reasons: first, they will not succeed on account of the changes in the relative dimensions of the two sides of the vertebræ, and of the connecting structures contin-

gent on their curved shape; secondly, owing to the twisting of the vertebræ which invariably accompanies the incurvation, the several processes and articular surfaces are so much altered in their relative positions that they become mutually interlocked, and the movements between them are checked or arrested. Accordingly, as the lower curve cannot be spontaneously overcome, and the equilibrium must be restored, the only alternative is the formation of a new one above it, and in counteraction of it. The spinal muscles on the convex side act on the upper part of the spine; and by gradually raising it and drawing it toward the median line, they eventually bring its summit over the seat of the centre of gravity. The muscles attached to the head and to the shoulders contribute to adjust them also, and direct them towards their correct places. Thus the superior or dorsal curve is formed.

FIG. 98.

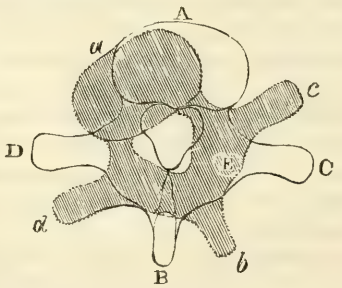


A, B, oblique line of pelvis when standing on right leg; C, D, line indicative of the tendency of the trunk to fall to the left when standing on the right leg; C, D D, curvature of spine consequent on oblique direction of the pelvis; *a*, *b*, horizontal line of pelvis, as in the posture of sitting; C, *d*, position towards which the spine, having become curved in the loins, is liable to fall when the pelvis is placed horizontally. The curve in the loins being permanently established, the exertions of the patient to restore the equilibrium tell only on the part of the spine above. The dotted lines C, *d*, C, d^1 indicate the line of the formation of the lumbar and dorsal curves.

Causes of the rotation.—It may now be inquired into, how the twisting of the spine on its long axis, which is an invariable accompaniment of the lateral incurvation, is produced. It is about equal in degree both in the lumbar and dorsal curves, and has also a definite relation to the curves; being always directed in such a manner that the concave sides of the vertebræ are wheeled forward, and the convex, of course, backward.

It has been stated above, when adverting to the surfaces and processes by which the vertebræ are articulated, that the only solid structures, as distinguished from the

FIG. 99. Diagram illustrative of the invariably simultaneous rotation of vertebræ in Scoliosis.



A, B, C, D, normal position of a normal lumbar vertebra; *a*, *b*, *c*, *d*, rotated position of the same; E, supposed chief centre point of rotatory movement—namely, in the most compressed and absorbed articular processes of the several lumbar vertebræ, more or less, on the right side.

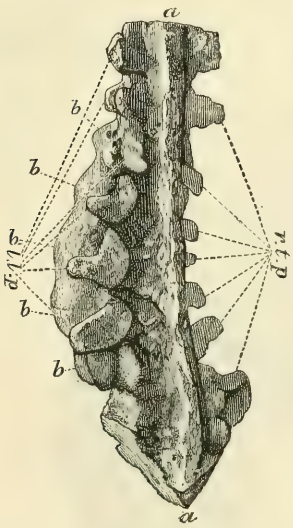
muscles and ligaments, which intervene to check or arrest lateral movement in them, are the articular processes. It was also shown that, when the muscular and fibrous structures were inefficient, and the spine inclined to one side, the effects produced on these processes by the pressure of the superincumbent weight differed essentially on the two sides of the column; that from the weight being received wholly on the concave side, the articular processes of that side were shortened and flattened by absorption; while, owing to the processes on the convex side escaping compression, they preserved their normal shape and size, and diverged from each other. The influence which this contrast in the rate of simultaneous twisting and absorption of the substance of the vertebræ on the two sides may have in causing lateral incurvation will be apparent when we take into view the relative position of these processes

to the central axis of the spine. They are placed postero-laterally in the vertebræ. Consequently, at the same time that the column falls sideways, a rotatory movement, in a partially horizontal plane, will take place upon the articular processes of the concave side as centres or pivots; and the vertebræ will, therefore, perform a partial rotation, with their sides, which have undergone the chief destruction, pointing forwards.

Dr. Judson has contrived an ingenious and useful mode of artificially articulating the vertebral bones, very illustrative of this influence of the anatomical form of the articular processes in favouring rotation.[1]

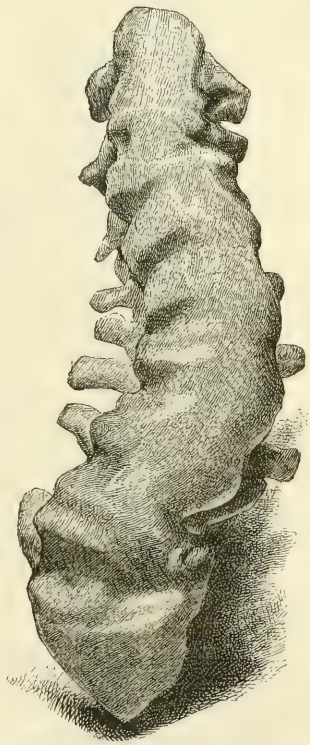
If, however, instead of a normal lumbar vertebra, we take a dorsal or lumbar vertebra from the body of an advanced scoliosis subject, as in fig. 100, we find, in

Fig. 100. The lumbar portion of a case of probably Rachitic Scoliosis seen from the left side.



a, *a*, the almost straight line of spinous processes; *r*, *t*, *p*, the right transverse processes approximated to the spinous ridge; *l*, *t*, *p*, the left transverse processes, unduly distant from the spinous ridge; *b*, *b*, *b*, *b*, *b*, the bodies distorted anteriorly, and to the left. It will be observed also that opposite to *b*, *b*, *b*, *b*, *b* is a series of knobs or prominent elevations, each of which corresponds with each intervertebral substance. This protuberant appearance of similar displaced vertebræ has been before pointed out in rachitis.

Fig. 101.—Front view of the same specimen.



Showing the anterior bulge of lumbar vertebral bodies and their rotatory curve to the left, the irregular disposition of the transverse processes, and the protuberances at the intervertebral junctions. The drawing of this specimen has already been published without acknowledgment of its source.

addition to its observed rotation on its horizontal axis, and its hitherto described changes in form, that the relation of the transverse processes to the spinous process is much changed—the transverse and spinous process on the concave side have become approximated, say, in the lumbar vertebra, half an inch, and sometimes upwards of half an inch, the space between the spinous and transverse processes being much narrowed in the hollow side, with corresponding increased space between them on the protuberant side. This is well shown in a specimen of lumbar scoliosis obtained by Mr. L. S. Little, models of which were deposited by him at the London, and the National Orthopædic, Hospitals. The above drawings (figs. 100, 101) of it bring out

[1] Judson, *The Cause of Rotation in Lateral Curvature.* New York, 1876. This gentleman has been good enough to present to the London Hospital Museum one of the contrivances in question. It shows also the contributing share of the weight of the head and upper extremities in producing scoliosis in predisposed subjects.

well the relative straightness of the spinous ridge (see fig. 100), whilst considerable twisting and deformity of the bodies exist.

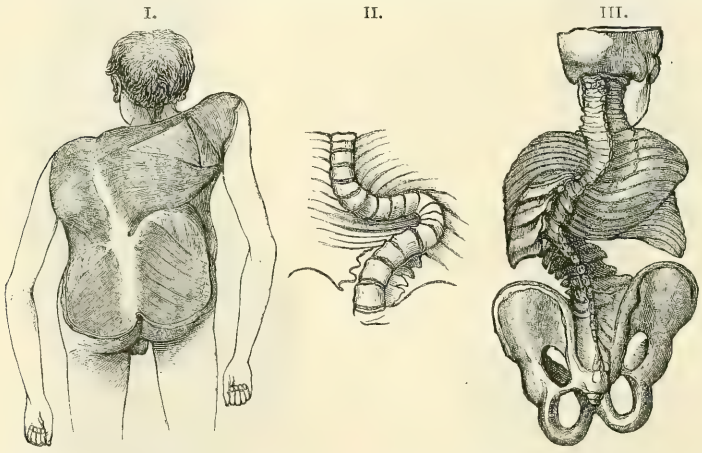
This subject would be incomplete without the addition of the following figures, published by Mr. Little, in the 'London Hospital Reports,' 1867.

The first exhibits the subject of severe scoliosis, with the dorsal muscles dissected. The gibbosity is considerable, and the consequent alteration of the proportions of the trunk and upper limbs well marked. The third figure shows the dissected skeleton with the considerable double curve; but neither the first nor third figures would give any indication of the surprising twist of the bodies, as shown in the front view of the column at No. II.

Special appearances at different curves. Trunk.—Decrease of height, and increase of breadth in the trunk generally, with consequent disproportionate length in the extremities.

Lumbar curve.—Owing to the thickness of the mass of muscles in the loins, and the natural arching of the vertebræ forward causing a hollow behind, the lumbar part of the column does not come so distinctly into view as the dorsal; hence it is not always easy to discover a curvature in it, especially at its incipient stage. The only apparent sign of there being one may consist in the waist being peculiarly

FIG. 102.—Unusual form of Dorso-lumbar Scoliosis to the right side, showing the disproportionate distortion of the bodies compared with the line of the spinous processes.



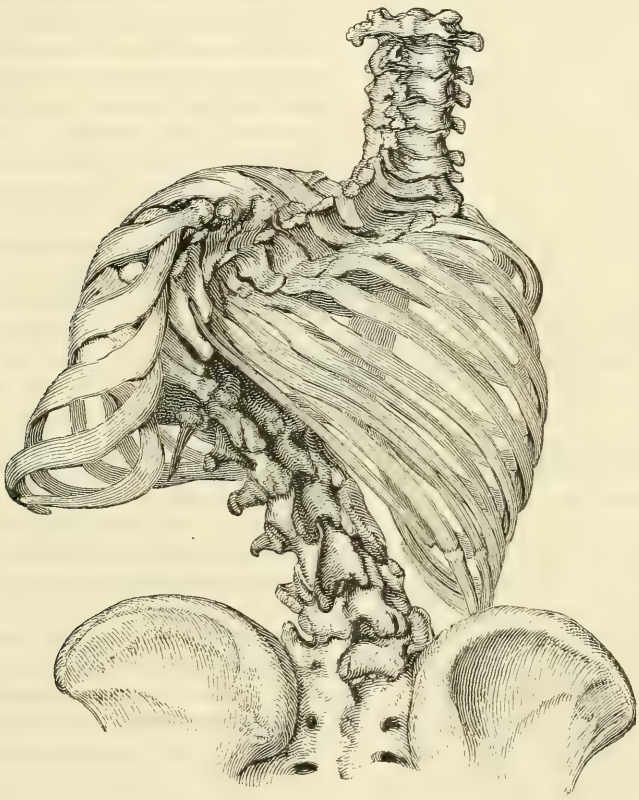
short and broad, which indicates that the lumbar vertebræ have yielded to the pressure of the superincumbent weight and become curved. To estimate the weakness of the part, the patient may be instructed first to place herself in a lounging posture; the clumsiness of the waist will then be perceptibly aggravated; but, by asking her again to make a strong effort to elevate her body, a visible improvement in the proportions of the waist will take place, which will last so long as the exertion is continued.

Supposing the deformity more advanced, the first thing perceived in the loins will be a want of symmetry between the two sides—a narrowness and fulness on the one, and an expanded sunken condition on the other; the contrast being more apparent if the patient stand in a slouching position. Accordingly the muscles which lie upon the vertebræ on the full side will be stretched, and also thrust back, so as with the transverse processes situated beneath to form a curved, rounded swelling (see p. 429). If the twisting be considerable, the consequent displacement of the muscles may be so great that their inner margins, in relation with the vertebral ridge, will overlap the points of the spinous processes, and conceal them. As in cases of slight curvature, the fulness may not be easily recognised; the best mode of bringing it into view is to direct the patient to bend forward, as in making a bow, when the inequality will be distinctly visible.

In proportion as a lateral curve at any part of the spine becomes more acute, the accompanying rotation or twisting is increased; and the bulging at the convex side is augmented to a corresponding degree. That condition is much more visible in the dorsal (see fig. 95) than the lumbar region; yet cases have been met with, in the loins, wherein the rotation of the vertebræ on their long axis has equalled not less than a quarter of a circle in its circuit; and in which the vertebræ at the principal bend, when looked at from the back, were seen in profile instead of posteriorly.

Another effect produced upon the figure, by the lumbar curve in connection with the pelvis, may be noticed. As the vertebræ spring from the sacrum, they may incline, in the first part of their course, at such an acute angle to the left that they

Fig. 103.—Posterior view of extreme Scoliosis. (Reduced from an engraving, taken from a drawing by Sir C. Bell, in Mr. John Shaw's folio work on 'Distortions of the Spine,' favoured us with MS. explanation by Mr. Alexander Shaw.)



follow the line of the brim of the pelvis, and are in close proximity to it. The consequence of this near approach is that the boundary of the upper margin of the wing of the ilium is concealed; and the surface of that part of the region of the hip being nearly on the same level with that of the ridge of the spine, they appear merged into one. The result is, that the hip seems not only greatly enlarged, but elevated above its normal height. The sense of spinal weakness at this part is sometimes in middle-aged persons relieved apparently by the lumbar vertebræ resting upon the left ilium, or by the ribs on the right coming into contact with, and resting upon, the right ilium, as in fig. 103. The Museum of the Royal College of Surgeons of England contains a specimen of arrested scoliosis, through the deposit of bony plates along the front of the vertebral bodies.

The appearance of the lumbar region on the concave or right side of the curve presents a general contrast to that on the convex. Owing to the spine receding from its base to the left, in forming the curve, the right side has greater breadth across

than the opposite; and, owing to the column being rotated on its long axis with the right sides of the vertebræ forward, a flatness, or hollow, or even a flexure in the surface, is produced. But a notable difference between this side and the convex will be perceived, especially in the form and situation of the waist. Owing to the inclination of the spine to the left, the right side of the pelvis becomes particularly distinct, and juts out like a promontory. Consequently, this lower boundary of the waist comes conspicuously into view, and the flexure above is abnormally deep. The contraction, however, on the left, which alone corresponds to a waist, is merely a hollow in the side, from depression in the ribs, and is situated far above the level of the proper place of the waist: so that a line drawn between them would be highly oblique, instead of horizontal. The difference in form of the two sides of the waist in an average scoliosis is well shown in fig. 95 .

Fig. 104.—Supposed transverse section of the Thorax about its middle: to show the displacement of the ribs consequent on the rotation of the dorsal vertebræ.

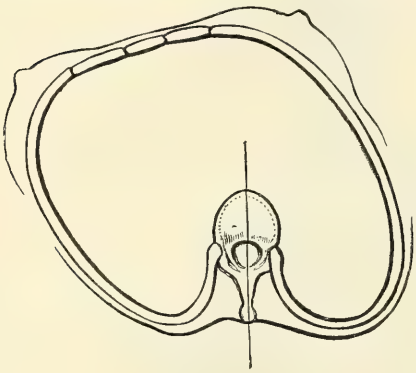
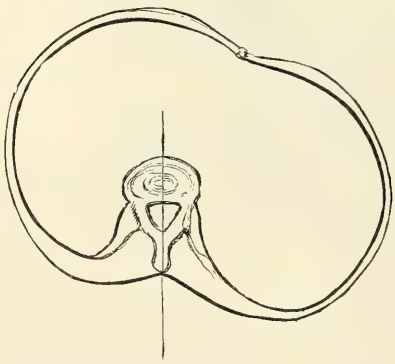


Fig. 105.—Diagram representing a supposed transverse section of the Abdomen, at the lumbar region.



Chest.—From the upper or dorsal curve being situated in the part of the spine to which the ribs are attached, the walls of the chest are included in the deformity. Again, as the scapulæ rest on the chest, the position of the shoulders is also involved. Further, owing to there being a natural stoop forward at the dorsal region, the features of the distortion are rendered to a certain degree more distinct than below.

On examining the dorsal region of a patient in whom the deformity is incipient, the first thing to be remarked here, also, will be a want of symmetry on the two sides. Supposing the case to be one of an average kind, there will be increased fulness and elevation on the right, and contraction with depression on the left. The line of the lateral curve will, to some extent, be traced by following the course of the spinous ridge. But, in order to estimate the accompanying rotation, the elevations on each side of the ridge, corresponding to the transverse processes, must be looked to; when that upon the convexity will be found abnormally protuberant, and that upon the concavity proportionately depressed.

Attending next to the ribs: the changes in their position are twofold, depending on distinct causes. Taking the convex side first, the ribs radiate from the spine, like the rays of a fan, so that the distal ends are separated and the intercostal spaces enlarged; but, in addition to this, they project backwards (see fig. 103). Looking next to the concave side, the ribs converge, like the spokes of a wheel concentrating to the axle, and their distal ends approximate; but, in addition, they advance forward. Hence it will be perceived how the right half of the chest, as looked on posteriorly, should be both abnormally expanded and protuberant; and the left both contracted and depressed. Again, it will be found, as might be anticipated, on turning the eye to the front, that the anterior ends of the ribs and costal cartilages are flattened or depressed on the convex or right side, and prominent on the left. The chest appears, therefore, as if the left half were moved forwards and outwards, and the right half backwards and inwards. The left mamma consequently presents more

prominently outwards than natural (see fig. 104). These changes in the directions of the ribs depend, it is obvious, on the analogous ones in the spine : the ribs being like the indicators on a dial plate, magnifying the movements at the centre. The radiation on the convex side results from the divergence of the articulating surfaces appropriated to the ribs on that aspect of the spine, connected with the lateral incurvation, and the projection posteriorly results from the rotation of the vertebræ on their long axis. A similar explanation, but with the order of the changes reversed, applies to the concave side.[1]

Shoulders.—From the scapulæ being placed loosely on the summit of the chest, and retained in their places only by the muscles, and by their articulations with the clavicles, they are free to rise, sink, protrude or recede in conformity with the variations in the forms of the chest. As the upper ribs, of the convex side, which support the *right* scapula, are both elevated and directed posteriorly, the shoulder is not only raised above its ordinary level, but projected backwards : hence it is high and bulging as if enlarged, and fits closely against the side. The ribs on the concave or *left* side are pointed downwards and forwards, so as to cause a general collapse of the upper region of the chest : the scapula is thus deprived of support, and is held in its place principally by its attachment to the acromial end of the clavicle : the shoulder, therefore, falls down by its own weight and that of the arm below its proper level ; it also stands off apart from the body, with a flattened and pendulous appearance. It will presently be seen that, in certain extreme cases of the deformity, in which the ribs on the convex side are wound about the vertebræ as a consequence of the contortion, that side is diminished transversely and loses its rotundity : the right scapula will then descend from its elevated position to the level of its fellow on the left. Occasionally the chest, together with the shoulders, is turned, as upon a pivot, by the wheeling round of the spine, to such a degree that its left side will face to the front and its right to the rear, to such an extent that the medullary canal can be seen into from between the ribs. A remarkable illustration of this fact is afforded by the distorted spine in the skeleton of a prematurely overgrown young giant (nearly 8 feet), preserved in the Museum of the College of Physicians at Philadelphia. The clavicles will revolve equally ; and the displacement of one of these at its sternal articulation from this cause has been known to be so great, that it has pressed on the trachea, so as to threaten suffocation, and necessitate partial excision.

When lateral curvature, from neglect, becomes worse, the increase is almost always more apparent and extensive in the dorsal than in the lumbar region. With increase of gibbosity, an increase in the acuteness of the 'angles' of the ribs, with a flattening of their centres or bodies, appears. That change is obviously caused by the progress of the rotation of the vertebræ on their long axis. As the spine revolves, the ribs are drawn to it, just as a rope in machinery is coiled about a barrel in circular motion. Accordingly, in proportion as the vertebræ rotate, the proximal ends of the ribs travel backward, and, by so doing, increase the acuteness of the angles. Again, as a resistance is made to the posterior movement by the attachment of the distal ends of the ribs to the sternum, a stretching force is applied, which has the effect of straightening their arches and flattening their contour. As the contortion advances, the line of angles is carried further backward, till it forms a prominent ridge, concentric with the spinous, and more prominent. The muscles which lie in the vertebral groove are so much displaced by the twisting of the column, that their inner margins now overlap the tips of the spinous processes, and conceal them. When the deformity has proceeded thus far, the next stage in its progress is, that the proximal ends of the ribs, from their articulating heads to the angles, inclusive, are transported bodily round, in their bent condition, by the circumvolution of the column, so as to be in actual contact with the sides of the vertebræ, and to be coiled upon them. The twisting of the spine on its long axis is, of course, very great in these extreme cases—being equal, it may be estimated, in certain of the vertebræ, to nearly a quarter of a

[1] The appearances described above will be made more distinct by the patient's stooping, so as to protrude the spine and adjoining ribs ; as well as by crossing the arms in front, akimbo, to draw the scapulæ forward.

circle; and at the same time that the contortion proceeds, the spine becomes more acutely bent. From these combined causes, a prominent enlargement, standing out abruptly from the centre of the back, with expanded ribs overlying the spine for its summit, is formed, constituting the hump.

Simultaneously with those changes on the convex side, equally great ones are being wrought on the concave. In proportion as the spine revolves, the sides of the vertebræ and the ribs connected with them are carried forward; and as the column bends increasingly, the articular ends of the ribs are caught and enclosed in the deep parts of the angle formed by the upper portion of the spine with the lower. Consequently, the sides of the vertebræ, more particularly the oblique processes, and the posterior halves of the ribs, undergo heavy pressure from the superincumbent weight. Hence they become extensively wasted by absorption. Large portions of the postero-lateral parts of the vertebræ disappear: the intervertebral substances are greatly thinned, and the bodies present a skewed appearance. As to the ribs, they are not only huddled closely together, but may be attenuated so as to be scarcely thicker than goose-quills.

By degrees the hump may equal that which obtains in angular spinal deformity, or be even greater, with the characteristic difference that in scoliosis the disparity in size and form in the chest is apt continually to increase. It has often been said that there is no lateral yielding in angular curvature. This is true in the main, but the surgeon needs to watch the progress of angular curvature, and on the first appearance of lateral yielding take measures to check it.

It is manifest that important encroachments must have been made on the space within the chest, intended for the heart and lungs, by the changes in its parietes just described. All that part, for example, contained between the portion of the walls which had become folded about the spine, and the spine itself, on the convex side, would be lost to the pleural cavity. Again, from the contraction of the chest on the concave side, the room for the lungs would be greatly diminished. It may likewise be conceived that much embarrassment in the actions of respiration would result from the remarkable disfigurement of the ribs, particularly at their articulations. Nevertheless it is known that the various organs possess an extraordinary power of accommodating themselves, with at first little impairment of their functions. Often probably a predisposing cause of scoliosis has been the hereditary or acquired tuberculous diathesis. Some break down with early pulmonary phthisis, though less often than from previous vertebral disease. As age advances, suffering from internal disease may arise. The liver, stomach, lungs, and heart perform their functions with difficulty in the gradually increasing limited space allotted to them, organic disease of them follows, and shortens existence. We have, however, met with extreme scoliosis subjects nearly seventy years of age. In extreme cases of distortion, the compages of the thoracic and abdominal cavities present both singular irregularities, and all the viscera contained in them undergo a new moulding of their figures to adapt them to the changes. Thus the spinal cord submits to be altered both as to dimensions and shape, in accommodation to the tortuous form and abrupt angular bendings of the vertebral canal, without loss of function. On the concave sides of the curves, the intervertebral foramina become contracted and partially closed: it might be supposed that the spinal nerves would be pinched and injured in their passage through them; but experience shows that pain from this cause is an exception.[1]

In the earliest stage of scoliosis, all distortion may disappear on suspension or lying down, and it is probable that, with disappearance of the outward distortion, the column has temporarily become straight.

Undue mobility at the junction of the curves, especially where the lumbar curve

[1] It is said that a formerly well-known Sussex surgeon and palæontologist, who had scoliosis with great tumour in the left lumbar region, suffered so much pain that the tumour was attributed to cancer.

ends and the dorsal begins, is often present in advanced cases, and accounts for much of the apparent improvement visible when the patient is suspended or assumes the recumbent position, though the essential morbid rotary curves remain.

Diagnosis.—The deformities within the bounds of the spine and chest, with which scoliosis is liable to be confounded, are contracted chest and spine from pleurisy (see pp. 441 and 442), and (fig. 106) angular projection of the vertebræ consequent on caries or on rickets. The better to assist diagnosis we have juxtaposed the ordinary form of angular curvature from vertebral disease and that from rachitis. In determining the rachitic origin the surgeon will seek for other signs of that disease (vol. iii.) If the disease which causes the formation of the angle be seated in the dorsal region, the ribs attached to the column on each side are a bar to the spine bending sideways; but when the disease is lower, especially in the dorsi-lumbar region, there may be a slight deviation to either side, and the angular may then present some of the appearances characteristic of scoliosis. The principal distinguishing feature between them, so far as the deformity is concerned, is that rotation of the spine is an invariable accompaniment of scoliosis, and is rarely present, even in a slight degree, in angular: and as the signs of that twisting movement in the former are always recognised with ease, there ought to be no difficulty in perceiving the distinction. (See p. 406.)

FIG. 106. — Extreme Angular Dorso-cervical Spinal Curvature, from disease and caries of vertebræ (anchylosis).

Prognosis.—In anticipating the issue of a case of lateral curvature, it should be remembered that the flexibility of the spine, in youth, diminishes yearly. Now, as the greater the flexibility, the greater is the proneness of the deformity to get worse if neglected; and as the greater the flexibility, also, the more favourable is the condition of the spine for effecting a cure, it follows that an early commencement of treatment is urgently necessary, both for preventing increase of the curvatures, and for rectifying them. Again, as rigidity of the column increases with years, curvatures of old standing are less likely to become worse than those of recent formation; and, for the same reason, the prospect of success from treatment is more distant in them. Scoliosis, from its earliest to the latest stages, should be regarded as a serious affection; for, although not threatening life, it may be said to jeopardise the future social and physical happiness of the subject.

For testing the stability of the spine, and judging of the efficacy of the treatment, the best mode is, first, to put the patient's body on the stretch by extension and counter-extension; then, to measure the height, both when recumbent and when standing at its fullest, with accuracy; when that has been done, let her lounge at her ease for some time; lastly, let her height be measured after the spine has had time to sink down: the loss observed on comparing the measurements will indicate the mobility of the column.

Treatment.—By reclining in the supine position on an inclined board, the head and armpits being adequately secured to prevent the patient from sliding down, and the lower part of the body left loose, or with some mechanical appliance added to increase the traction, extension and counter-extension may restore the spine, more or less effectually, to its straight position. The benefit anticipated is, that, in course of time, when the vertebræ and connecting structures have been kept sufficiently long in their approximately normal situations, they will become reinstated in them by the influence of growth.

It cannot be doubted that this plan of keeping a patient confined on the back for a long period has proved more efficacious than others. But there are sundry objections to adopting it, especially as an *exclusive* mode of treatment: the chief of these are, the injury to the patient's health, which follows the prolonged confinement; the debility of the muscles that ensues from want of exercise; the comparative seclusion; and the interference with the pursuit of education. Amesbury introduced a useful

couch enabling the patient to combine exercises of the entire body and limbs in the recumbent posture. It has been a constant aim to find a fitting substitute for entire recumbency in spinal supports of various kinds. One of the chief recommendations of these is, that they allow liberty to the patient to walk or sit at pleasure, in common with others; and for that advantage she willingly submits to the irksomeness of wearing them. Whatever ingenuity may be exhibited in the construction—in forming a secure point d'appui at the hips—in introducing contrivances to hoist up the column, or to unbend it—inserting props for strength, or compresses to push the gibbous ribs inward—it is liable to fail; because the mobile human trunk cannot be acted upon as if it were made of insensitive inert material. The remark applies particularly to cases of incipient distortion, when the patients are about fourteen years of age. Later in life, when the vertebræ and ribs are more consolidated, and the pelvis more fully developed, a better purchase can be obtained for the centres of bearing. But when that time has arrived, the curvatures have generally become too stiff and unyielding for treatment of any kind to be serviceable, beyond affording relief to the feeling of weakness and pain.

Physical exercises are essential adjuncts of the treatment. They accomplish various beneficial objects; besides their use in strengthening the muscles, and preserving the health, they have the indirect effect (see p. 427) of increasing the density and solidity of the bones, and adding to the tenacity and power of resistance of the ligaments of the joints. Moreover, they may be made available for stretching the contracted parts in the concavities of the curves; and, by loosening the connections of the vertebræ, they will give greater facility to straightening the column by extension. Excepting in the earliest stage, when the disorder is too often not discovered, it would be vain to suppose that exercises by themselves could effect a cure. They can only be serviceable as auxiliaries.

It appears that, in order to do most justice in the treatment of cases of lateral curvature, the best course is to combine, in various proportions, according to the nature of the deformity, and the age of the patient, parts of the most reliable plans in use, viz.: 1. removal of predisposing and exciting causes; 2. gentle calisthenic and gymnastic exercises; 3. rest on the inclined plain, prone or recumbent: 4. manipulations by a rubber taught to exert particular efforts to reduce the lumbar curvature; 5. the wearing a very simple or more complicated support to head, chest, and spine, as the case may indicate. Experience shows, that when the time of reclining on the plane is broken into at due intervals, by exercises, short of fatigue, indoors and out of doors, the health, instead of being impaired, decidedly improves under the conjoint treatment.

Where a support is needed, the selection of it should not be left to the instrument-maker. Often a very simple support suffices, in which care is taken that there shall be no circular compression of the chest; that the abdomen and loins be well supported, by a firm abdominal band passing behind the back stem of the apparatus, to support, as much as possible, the lumbar vertebræ in front, where they are most disposed to yield. All scoliosis patients exhibit some undue hollowness of loins, and tendency to protrude abdomen. Attention to these points assists the removal of the lordosis. The overlooking of the need of abdominal support to the loins, and directing too exclusive attention to the dorsal distortion, explains many failures in instrumental aids to treatment.

The next point of treatment to be considered is the question of removal of the great weight of the head. This can only be done effectually by recumbency or by suspension, to both of which, through their interference with social intercourse, parents and patients often object. The 'Minerva,' a long known suspension apparatus,[1] has often proved useful.

Suspension of the head by pulleys and weights, whether seated in a chair or in a carriage, or when seated at a piano, has been employed by the orthopædic physician for the last two hundred years. The numerous contrivances for the purpose which

[1] See Little, on *Deformities*, p. 376.

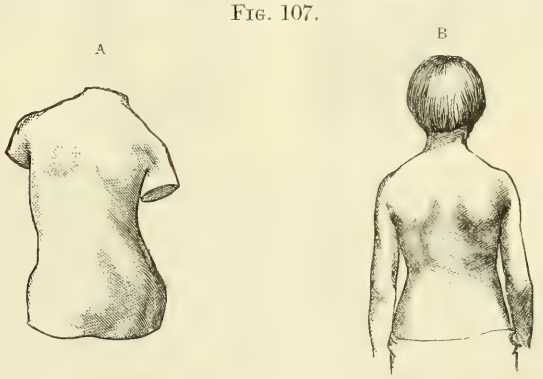
have been published, testify to the general appreciation of the necessity of removing the weight of the head, and the difficulty of effecting it.

The profession has been largely exercised of late by the advertisers of the asserted superiority of plaster-of-Paris,[1] and starch, and white-of-egg bandage, 'poro-plastic,' perforated leather, gutta-percha, or metal corsets. The whole of these contrivances, in the results of their use, often differ little in effect one from the other, or from ordinary whalebone stays. To the artisan, they may be superior as working materials, but they fail almost equally in the important respect that they are apt to press upon the shrunken side as well as upon the protuberant side. They disappoint as to cure, because they do little towards undoing the hidden curves, of which the visible ones afford no proportionate indication. They often satisfy the patient, because they do somewhat lengthen the trunk, afford support, and conceal much of the mischief.

On Curvature of the Chest and Spine after Pleurisy.

True or simple lateral curvature.—It is well known that when pleuritic effusion has taken place, the compressed lung is sometimes incapable of expansion, and being tied down by the unyielding fibrous adhesions, remains shrunk, so that the affected side of the chest-wall is drawn towards the contracted lung, is deformed, and appears a permanent and increasing deformity; whilst the unaffected lung and sound side of the chest expands to the fullest normal development, and sometimes beyond it, and appears preternaturally prominent. The collapse and shrinking of one side of the chest involves the vertebral column in the deformity; in short, the chest deformity could not occur without a simultaneous *lateral* curvature of the spine.

Fig. 107.



A represents a drawing from the model taken from a young lady, aged fourteen, who had been affected with pleuritic effusion two years before. The fluid had been spontaneously removed by absorption. It is the simple true lateral curvature of the spine, without the sigmoid twist, which characterises the rotatory lateral curvature of the spine, or scoliosis, commonly misnamed 'ordinary lateral curvature.' B represents a drawing, taken from a photograph, of the same patient twelve months afterwards. The intermediate treatment consisted of gymnastic exercises, and the use of the lateral sling so as to support the patient upon the prominent side of the chest a few hours daily, by which means the act of chest expansion being mechanically retarded on the sound side, expansion of the contracted side is favoured.

The lateral curve consequent upon pleuritic contracture being necessarily concave towards the contracted side of the chest, tends to force the healthy portion of the chest to the opposite side. Viewed in front or behind, there is on the contracted side approximation of the shoulder to the ilium (see fig. 107 A), causing a uniform lateral curve of the spine from the summit of the dorsal region to the bottom of the lumbar one. No other distortion of the spine exists in which a similar simple, continuous, lateral yielding of these regions takes place. It is, in fact, the only true lateral curvature. It has none of the sigmoid character, and no rotation of the vertebræ, which are more

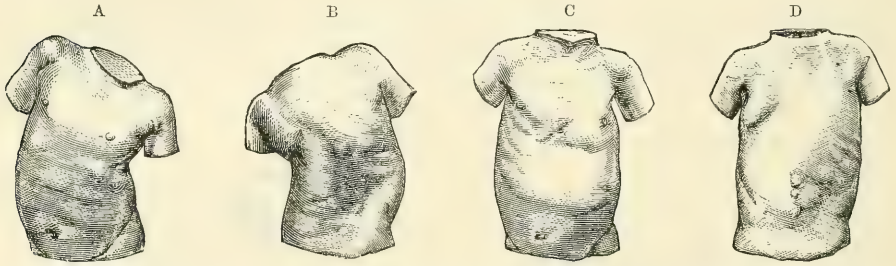
[1] The superiority of plaster of Paris and suspension of the head has been introduced here from America, with beat of drum (as well as the terms *rotary* and *rotato-lateral* curvature) as a new discovery. The use of gypsum as a means of supporting the head, and the use of the terms in question, were probably found in Little, on *Spinal Weakness and Spinal Curvature*, London, 1868, p. 107.

or less marked features of scoliosis, and which induced us to substitute the term rotatory or rotato-lateral curvature for that distortion.

This deformity appears to the casual observer similar to ordinary lateral curvature; and when slight, even the experienced eye may hesitate in diagnosis. When, however, the lateral curvature from pleuritic contraction is investigated side by side with ordinary lateral curvature, although they are in outward appearance similar, no two pathological states can be more dissimilar. The curve after 'recovery' from pleurisy is more uniform, and involves the entire column in one sweep; the depression of shoulder on the contracted side is relatively greater; the reduction of capacity of the contracted side applies to the front as well as to the back of the chest; the posterior angles of the ribs on the expanded side, and the internal margin and inferior angle of the scapula, are less salient (compare fig. 95 and fig. 108); and, as before stated, rotation of the vertebræ on their horizontal axes is entirely absent. It would be interesting to discover whether, in unrelieved cases of pleuritic chest-contraction, after many years' possibly unequal use of the muscles of the two sides of the trunk, any rotatory curve be superadded to the original deformity.

On looking at an ordinary severe scoliosis, as in fig. 103, the observer is there much struck with the bulge of the right side of the chest posteriorly and laterally, and the prominence of the inner margin of the scapula and of the angles of the ribs, and he would emphatically designate this side as the lapsed and most distorted side.

Fig. 108.



A represents a drawing, from a model, of the front of a child, aged six years, who had been affected with empyema two years and a half before. The matter discharged itself in the usual situation of the 'empyema of necessity,' beneath and posterior to the left nipple. B, taken from a model of the back, exhibits the deformity, as seen from behind, in the same child. The absence, in these pleuritic contractions, or true lateral curvature of the spine, of any rotation or twist, such as exists in scoliosis (and from which is derived the name), or rotatory lateral, usually misnamed lateral, curvature of the spine, is very striking. The case represented in A and B was an inmate of the London Hospital under our care in 1859. The treatment consisted in lateral slinging during some hours daily, and during the night, without the use of spinal support or gymnastics. C and D represent the same case six months later, when the restoration was almost complete. When it is considered that, the empyema having discharged itself, a fistulous opening had existed for several months, and that consequently the firmest kind of adhesion compatible with the youth of the patient had necessarily taken place, the result will appear surprising to those who still have regard to a considerable pleuritic contraction and deformity of the chest and back as the necessary and unavoidable permanent result of the severest form of pleurisy. It should be remarked, that all the models in question were taken whilst the patient remained recumbent; the photographs were taken whilst the patient was standing.

On the contrary, in lateral curvature from recovered pleurisy, the small shrunken side is undeniably the diseased one.

In both kinds of curvature, the enlarged side is more sinned against than sinning; but, in scoliosis or twisted spine, the larger side unmistakably partakes essentially in the entire pathological state, which, in the spine, ribs, muscles, and ligaments, induces the deformity; whilst, in pleuritic curvature, the larger side is essentially the healthy one, and is only physiologically developed to the utmost extent to compensate for the shortcomings of the contracted side.

Auscultation and percussion tend to confirm the diagnosis which the history of the case and ocular inspection and reflection have established.

Posterior curvature of spine (*excurvation*).—This round-shoulder distortion, like knock-knee, is a frequent consequence of atony, rickets and of old age. It can be distinguished from angular distortion, by the curve of the spine being a gradual one, no single spinous process being prominent in so marked a degree as in angular deformity by the existence of signs of rickets elsewhere, by the absence of the history of vertebral disease, which precedes angular deformity, and by its rarely reaching so great deformity as the angular form. A frequent exciting cause is the injudicious

permission of late hours in relation to age, the undue proportion of time devoted to sedentary pursuits. Where no rachitic element is discoverable, debility, from overgrowth, may have been the remote cause.

In the early stage this antero-posterior yielding of the vertebræ disappears when the subject is recumbent; but in the advanced stage the muscles situated in the concavities of the curves, as well as the articular surfaces, having adapted themselves to the altered relation of the parts, the change from the perpendicular to the recumbent posture effects no variation in the deformity of the dorsal region and seldom in the lumbar region, unless the thighs be flexed; by which means the psoæ muscles being relaxed, the lumbar vertebræ sink towards the couch. Even this temporary alleviation of the deformity, with the lapse of time, disappears. The injurious effect upon the thorax is less considerable than that resulting from other spinal deformities. The treatment consists in obviating the constitutional rachitic state, when still present; in removal of the exciting causes enumerated; and by a judicious system of moderate gymnastic exercises and youthful strengthening games. The posterior curvature in the upper part of the spine is accompanied with a compensatory curve in the dorso-lumbar region termed *lordosis, anterior curvature*, or *incurvation.*

The causes and treatment of the upper or posterior curvature apply equally to the lower or anterior curvature. A light spinal support, the action of which should tend to make a fulcrum of the most prominent part of the dorsal region, obtaining a leverage upon the shoulders by means of straps passing around them, is useful. This tends to reduce the upper curvature, whilst the lower part of the support, being buckled around the pelvis, will, by means of a broad strap acting on the front of the abdomen, tend to reduce the anterior curve. But, as physical exercises in the shape of the use of dumb-bells, clubs, the trapeze, and ordinary boy's out-door games are desirable, the support must be removed for such exercises at stated periods. If the lumbar hollow be very considerable in an advanced adolescent, the distortion may never be completely remedied. The most unpromising cases of lordosis, however, often yield to perseverance in physiologically directed special exercises.

Lordosis.

From paralysis from hip-contraction and luxation, congenital and acquired, and from excessive use.

Undue hollowness of loins is an ordinary prominent symptom of the above forms of disease. It is irremediable when the cause continues to operate. That which springs from excessive use, as in the acrobat, is due to the individual having, from forced continued exercise of the part, in special exercises during early life, gradually elongated the lumbar ligaments and the minor muscles, and so changed the articulating surfaces of the vertebræ that unphysiological postures become possible even into later life. Changes corresponding to these, doubtless, occur in other parts of the frame, as in the neck, head, and ligaments of the thigh-bone, &c.

Congenital hip luxation.—A strongly marked condition of lordosis may lead the practitioner astray as to diagnosis, if he be not made aware that it constitutes a marked symptom in a very different and more serious affection, viz. congenital hip luxation, especially when this is double. In this cause of lameness and impairment of the figure and strength of the individual, the powerful normal connection of the pelvis and trunk with the lower extremities is much abated, or even lost, owing to the heads of both femurs not occupying their natural position in the acetabulum, or from the ill-developed acetabulum occupying a site in correspondence with the displaced head of the femurs. In addition to displacement of position, all the bony parts concerned are small and wasted. The consequence is, as it were, that the pelvis, and with it the trunk, sink down between the thighs, the pelvis inclines unduly forwards, whilst, in order to recover his equilibrium, the individual throws the upper part of the trunk backward, thus engendering the remarkable hollowing and shortening of the loins—the lordosis. This is not the place to dwell upon the means proposed for the relief of congenital hip luxation. It is sufficient to say that the

attempts to effect a radical cure by operation have constituted, to say the least, a weakness on the part of surgeons practising orthopædic surgery.[1] They have all, as far as it is known, proved untrustworthy, which could not be otherwise, through their having been based upon hypothetical expectations and hopes rather than upon sound pathological experience. As to successful treatment, it must be confined to the attempt to delay and arrest, during the years of growth, the gradual degradation of the head and neck of the femur, which takes place more or less rapidly according to the amount of exercise taken, by advising the parent to prevent the patient taking any considerable walking exercise that can be avoided, or the use of sticks or hand-crutches, and recommending daily airings on the water or in land carriages. When the surgeon can by manipulation replace the head of the femur in the socket, it mostly slips out again immediately. We have commonly prescribed a tolerably tight india-rubber bandage, or a webbing strap and buckle to be worn around the hips, to attempt to limit the tendency of the bone to further displacement. We have seen this congenital luxation hereditary, although it is said sometimes to result from accident, or from art interference during parturition. When such is the origin, the luxation probably is single.

Paralytic spinal curvature.—We have (p. 443) alluded to the influence of paralysis in the production of one form of lordosis, which is an instance of the operation of unequal or impaired muscular power, producing spinal curvature. Many years ago we published illustrations [2] of severe helpless paralytic spinal curvature which were exceptional cases, and mainly interesting to the pathologist by showing how great malformation may result from this cause. These were cases resulting from severe disease of medulla spinalis in childhood (progressive muscular atrophy and others). We also gave an illustration [3] of spinal curvature from hemiplegia in childhood. Considerable spasmo-paralytic scoliosis, as stated in this work (p. 247), may arise from the effects of asphyxia neonatorum. Dr. Louis F. Stromeyer in the outset of his career attributed ordinary scoliosis to paralysis of the inspiratory muscles,[4] a view to which we have been unable to subscribe. Dr. Schaffer,[5] in a recent able lecture, speaks of a paralysis in scoliosis, which is not in our opinion a correct use of the term paralysis, because he simply refers to the weakness and wasting of muscle following disuse. We have said sufficient to show that paralysis is a very exceptional element in spinal curvature.

Active spasmodic and hysterical scoliosis.[6]—We have met with several cases of well-marked considerable scoliotic distortion of spine, due to active morbid muscular action. Two of these were in-patients of the London Hospital. All were in young females between the ages of ten and twenty years. In more than one, circumstances were observed in the demeanour which left no doubt of the hysterical character of the disorder; one was more than twelve months under observation, and underwent no fluctuation in degree, or positive amelioration. The curvature of the column to the *left* in the dorsal region was so considerable as to excite surprise that the anatomical conformation of the spine could permit so considerable a deviation with hysterical suddenness; for occasionally, on distracting the patient's attention, the spine became quite straight. One of the hospital cases was a precocious girl of thirteen, probably of hysterical temperament: the distortion was distinctly spasmodic, and no volitional influence in the production of it was *discoverable*. After spending ten days in bed, subjected to the regulations in force, applicable to all patients supposed to be ill enough

[1] Whilst these leaves were in the hands of the Editor, we read in Esmarch (*Bericht der Königl. Chirurg. Klinik*, Kiel, 1880) a case of 'Luxat. Coxæ Cong. (Weib) *geheilt* nach mehrmonatlicher Behandlung mit Streckverbänden. Der Fall wird demnächst publicirt.' Has the benefit proved to be permanent?

[2] Little, *Treatise on Deformities of the Human Frame*, p. 360. [3] *Ibid.* p. 112.

[4] L. F. Stromeyer, *Ueber Paralyse der Inspirations-Muskeln*, Hanover, 1832.

[5] The *New York Medical Gazette*, April 1881, p. 125.

[6] We prefer these terms to 'simulated' (Jules Guérin) or 'mimetic' (Paget), because we are satisfied that very often the subjects have probably never seen a case of similar deformity. By the use of the term hysterical we absolve the individual from the charge of attempting to deceive.

to require confinement, she requested permission to dress and walk about the ward. This being refused on account 'of the severity of her case,' the spasmodic affection subsided after the lapse of a few days more, when she was handed over, 'cured,' to her friends, with suitable injunctions as to her future management. Such cases, with tonic diet, and rest, with the favourable social and moral influences of a well-regulated hospital, upon such forms of nervous disorder, usually do well quickly. In private life, the surroundings of such cases are sometimes anything but favourable.

In none of these cases did secondary changes in the form of ribs exist. The neurose character did not affect the nutrition and development of parts, after the manner of ordinary scoliosis.

Hysterical or emotional spinal curvature sometimes assumes the form of angular curvature in the lumbar region, the spinous process of the 1st lumbar, in fast-growing tall girls, standing out sufficiently to induce parents and medical practitioners to seek an additional opinion. We have seen several of these instances, in which the spine prominence was very marked, and much resembled that of angular *disease*, but all other signs of disease were absent. The history of these cases has usually been the following: at the expected menstrual period, the individual has been asked whether she had pains in the back; the back has been examined, and a prominent point discovered by the too anxious parent, who was ignorant that the last dorsal or the 1st lumbar vertebra is apt to increase in size, be prominent, and complete its growth, about the time that the pelvis rapidly enlarges. In girls who do not carry themselves fairly upright, the physiological growth is mistaken for a morbid state. The statements and reflections thereon are heard by the girl, her mind yields to the prevailing impression as to existing disease. With tact the physician can always show that the prominence is a removable one, under the influence of the patient's volition, which cannot be done when *disease* exists. By the physician admitting the patient into his confidence, that there is no incurable disorder, and that it will soon get well, and with prudence on the part of the living environment, the cure is effected.

W. J. Little.

SURGICAL DISEASES CONNECTED WITH THE TEETH,

AND THEIR TREATMENT.[1]

THE limited space allotted to this essay compels me to forego, to a great extent, dwelling on those diseases which most commonly fall under the special care of the dentist, and to confine myself, almost entirely, to those surgical *complications* which are associated with, and dependent upon, abnormal conditions of the teeth.

The subject of 'teething,' and the ailments of childhood contingent on that process; the irregularities and deformities depending on the shedding of the temporary teeth, and the advent of their permanent successors, would alone occupy, if treated with justice to their importance, more space than could be afforded to the entire essay.

Another matter which is of the last importance in the treatment of the teeth, *stopping* or *plugging* carious cavities and other defects of the surface, is a subject of such extent, and involves so much preliminary discussion upon purely physical questions, that it is impossible to enter here upon its consideration. Indeed, the treatment of those most usual and ordinary abnormalities of the teeth, irregularities of the position of the permanent set in young people, and carious cavities, entail to so great an extent a particular mechanical knowledge in combination with surgery, both its science and art, that it has naturally, and indeed inevitably, assumed that *special* character of practice and of surgical treatment which we see at present accorded to it; and for these reasons, combined with the want of space which I have before mentioned, I am constrained to refer the reader, for the consideration of these subjects, to those works which have been specially devoted to their elucidation.

In the following pages, therefore, I shall describe, as far as my limits allow, those surgical diseases and abnormalities, with their treatment, which are more or less connected with the teeth, under the following heads:

I. Alveolar abscess.
II. Painful and difficult eruption of the wisdom-teeth.
III. Tumours of the gum.
  (*a*) Epulis.
  (*b*) Congenital hypertrophy of the gum and alveolar borders of the maxillæ.
  (*c*) Polypus of the gum.
  (*d*) Vascular tumours.
  (*e*) Warty tumours of the gum.
IV. Tumours of the tooth-pulp.
  (*a*) Polypus of the tooth-pulp.
  (*b*) Sensitive growth of pulp after fracture.
V. Odontomes, or tumours of the hard tissues of the teeth.
  (*a*) Enamel nodules.
  (*b*) Exostosis.
  (*c*) Hypertrophied fangs.
  (*d*) Dentine excrescence.
  (*e*) Warty teeth.
VI. 'Abscess' of the antrum.
VII. Dentigerous cysts.

[1] The author is indebted to Mr. Coleman for much kind assistance in revising the present edition of this article.

VIII. Alveolar and maxillary necrosis from
(*a*) Phosphorus fumes.
(*b*) Eruptive fevers.
IX. Hæmorrhage after extraction.
X. The application of obturators and artificial palates.

I. *Alveolar abscess.*—One of the commonest consequences of dental caries, and occurring occasionally independent of any apparent disease in the teeth, is this troublesome, and too often ill-understood, malady. The results of this condition, when appearing on the external surface of the face (cheek, jaw, or chin), are occasionally so remote from any obvious connection with the teeth, and the patient's symptoms so fail to indicate its association with them, that the true nature and cause of the suppuration is lost sight of, and an easily-remedied disease is indefinitely protracted.

Alveolar abscess may be defined as a suppuration around the fang or fangs of a tooth, usually carious, accompanied by absorption and expansion of the bony walls of the alveolus or alveoli, and the enlargement of the little pus-sac, the matter gradually finding its way to the surface either along a canal by the side of the fang of the tooth opening at the edge of the gum, or through the gum itself at a point corresponding to the end of the root (or roots) of the tooth implicated. When, however, the fangs are unusually long, or the reflection of the mucous membrane, from the gum to the cheek or lip, is very superficial, this same discharge may burrow still more outwardly, and find its exit upon the surface of the face.

The pathology of alveolar abscess, especially in its commonest form of 'gum-boil,' was long misunderstood. The first change which occurs in the development of this condition consists in the deposit around the extremity of the fang or fangs of the tooth of organisable lymph, which is soon differentiated into obscure fibrous tissue. Coincident with this development, the bone around the end of the tooth-fang becomes absorbed, and a little hollow in the jaw is produced, varying in size from a lentil-seed to that of a horse-bean. Thus far the change is simply one of plastic inflammation: it occurs, as far as my observations go, with every carious tooth, and in those with more than one fang is most conspicuous at the extremity of that root which corresponds with the side or part of the crown where the caries occurs.

These changes are often accompanied by absorption, to a varying amount, of the extremity of the fang; and this appears to be part of the same action as produces the excavation in the maxilla itself, which is occupied by the plastic exudation. There is generally, too, a thickening of the alveolar periosteum, which raises, and often loosens, the affected tooth.

It is the lymph surrounding the extremity of the fang, and occupying the little cavity produced by the bone-absorption, that is the seat of suppuration in alveolar abscess. Whatever may be the first actual point of suppuration, when sufficient pus is formed for recognition, it is found in immediate contact with the fang of the tooth—the bare, naked crusta petrosa, and surrounded by the half-organised lymph, as by a sac. The form of this sac varies considerably; it is usually spherical or pyriform where the fang is single, or if the tooth have more than one fang, and the fangs are distinct; but where the fangs are close together, or the root is simply cleft at its extremity, as is often the case with the superior premolars, the sac is frequently double and bilocular. The sac is sometimes of large size, and is frequently very long; sometimes it is fringed with fimbriated processes of lymph, which occupy an elongated excavation in the maxilla. When suppuration is established, the sac enlarges according to the amount of matter formed, and the rapidity with which it is developed; and this is accompanied with a dilatation and absorption of the bony walls of the abscess, especially towards the region at which the matter is 'pointing.' These latter changes are often very extensive and very rapid; so that the whole of the osseous tissue of one wall of the alveolus may be expanded and thinned into a mere papery film, and then completely absorbed in comparatively few hours, the periosteum, with the organised lymph that has been the seat of the suppuration, alone remaining as the membranous sac of the abscess. The development of an alveolar

abscess is generally accompanied by a deep throbbing pain at the part affected, and often by great general swelling of the face, sympathetic of the more internal mischief. The distortion of the countenance from this cause is sometimes prodigious, especially when the upper incisors or canines are the cause of the abscess, and the attack is acute. In such a case the nose will be pushed on one side, the eyelids become œdematous, closed, and ecchymosed. In other instances, where the character of the affection is less intense, a mere indurated, indolent, and hard swelling on the side of the jaw is all that is produced; the maxilla being distended at the extremity of the tooth's fang, and but little bone absorbed.

The development of an alveolar abscess is sometimes associated with febrile symptoms of extreme severity. M. Robert [1] describes a case of alveolar abscess, resulting from a carious wisdom-tooth, which led to necrosis of the surrounding bone, and diffuse purulent infiltration of the side of the neck. The case terminated fatally.

Alveolar abscess is usually confined to the tooth or one fang (when the tooth has more than one) which has been the cause of the affection, and around which the plastic exudation has formed. Occasionally, in two- or three-fanged teeth, the intervening bone between the extremities of the individual fangs becomes absorbed, and one abscess may be common to all. Again, there is another form of alveolar abscess which occasionally affects the upper jaw and front teeth in persons of cachectic and debilitated constitution, in which suppuration appears to affect generally the tissues surrounding the roots of several teeth in a diffuse manner: the teeth become excessively loose, and the front of the jaw around them becomes boggy and suppurates abundantly, the discharge usually flowing around the necks of the teeth. In such cases the teeth are often, indeed generally, sound, and are probably only secondarily affected. I incline to the opinion that this form of alveolar abscess is dependent on constitutional taint—scrofulous or syphilitic.

The 'pointing' of the matter in alveolar abscess is a question of some moment, both as regards diagnosis and treatment; and the circumstance that the discharge of pus may occur upon the surface of the face, entailing it with very great disfigurement, adds serious importance to this consideration.

An alveolar abscess affecting the one-fanged teeth may find vent for its secretion by a gutter or channel along the course of the fang, the matter being discharged at the neck of the tooth. This seldom occurs to the many-fanged teeth, and is most commonly seen with the inferior incisors—the pus flowing from the front edge of the gum at a point corresponding with the particular tooth affected. The commonest position at which the thinning and bursting of the abscess takes place is on the outer surface of the jaw, at a point corresponding, as nearly horizontally as may be, with the extremity of the fang of the affected tooth, and *piercing the gum within the mouth.* In such common cases the diagnosis is perfectly simple and obvious, and the abscess is easily associated with the individual tooth that produces it. There are, however, instances in which the pointing of the abscess, after having taken a lengthened and burrowing course, is remote from its cause. The most striking peculiarity of this kind is where a circumscribed collection of matter appears far back in the palate, occasionally at the very posterior extremity of the hard palate, dependent on affection of one of the six front upper teeth. Such a condition may readily fail to indicate its true explanation, and may suggest the presence of necrosed palatal bone; it is important, therefore, in the practice of general surgery, to recollect that this obscurity may present itself. As far as my own experience has gone, caries of the *superior lateral incisor* tooth has generally been the cause of this remote pointing abscess. Why it should be so, I cannot say; but the pathological anatomy of the affection is the same as in ordinary cases, only the canal of the abscess is lengthened out in the narrow cancellated bone between the two compact plates of the palatal process of the superior maxilla. A critical scrutiny of the front teeth (incisors and canine) will scarcely fail to show which is the offender.

[1] *Conférences de Clinique chirurgicale,* par M. A. C. Robert, p. 145. Paris, 1860.

The forms of alveolar abscess which we have just considered are trivial in their importance in comparison with those which, in their advancing course, involve the integument of the face. It is a curious circumstance that alveolar abscesses, when pointing externally upon the face, have been so frequently misunderstood by surgeons, having been mistaken either for idiopathic abscess in the substance of the cheek, or suppuration associated with necrosis of more or less of the maxillary bones. To the superficial observer (and, indeed, in its consequences) there is a vast difference between a common gum-boil and an abscess which pierces and discharges its contents upon the surface of the cheek; but the cases are the same, barring the point where the pus is evacuated.

The circumstances which determine the pointing of an abscess upon the surface of the face appear to be either an unusual length of the fang of the tooth, or a superficial reflection of the mucous membrane from the jaw to the cheek; so that, in either case, the abscess which is forming round the extremity of the fang does not correspond horizontally with the gum within the mouth, and thus in its course outwards it passes either above or below (as it may occur in the upper or lower jaw) the line where the mucous membrane folds from one surface to another. In some cases, however, it takes an outward form irrespective of these conditions.

I am not aware that alveolar abscess, associated with the superior incisors or canines, ever points upon the surface of the face; the bicuspids, first and second molar, and all the teeth of the lower jaw, may produce this form of the disease. In the upper jaw the abscess appears upon the cheek at a point corresponding with the extremity of the tooth's fang, under the edge of the malar bone; in the lower jaw it forms along the edge of the jaw below the buccinator muscle when the molars or bicuspids are its cause; but when associated with the inferior incisors (canines also ?), it points frequently beneath, and sometimes in front of, the chin.

When an alveolar abscess is about to point externally, the integument becomes firmly glued down to the bone around the spot where the matter ultimately appears; the area within this space is red, distended, and glistening; the skin becomes thin and papery, and the epidermis scales off. If the surface be kept dry, the breaking of the abscess is often tardy and delayed; but it ultimately bursts through a jagged opening, which soon changes into a small fistulous orifice, surrounded by a pouting circular lip of granulations, that sink into a depression, surrounded by the adhesions which limit the pus-discharging canal. The appearances now are very characteristic, and when once recognised cannot be afterwards mistaken. Sometimes the lip of granulations becomes elongated into a papilla, and is covered with cuticle. I have seen one more than half an inch in length. The apex of this papilla has an orifice, which is the outlet of the fistulous canal communicating with the abscess; it frequently closes for a time, but bursts again as the matter accumulates. When once this papilla forms, it returns again and again, after excision by the knife, till the cause of the whole malady (the carious tooth) is removed. Another curious modification of the external orifice of the alveolar abscess is occasionally seen when it pierces the under surface of the chin; in such a case a *pad* of granulations sometimes forms, as large as the area of one's thumb-nail, from the centre of which the discharge flows.

In children, with the milk-teeth, alveolar abscess very seldom opens on the surface of the face. I have, however, seen a few such cases. On account of the extreme thickness of the alveoli in them, the end of the affected fang frequently appears through the orifice of the discharge within the mouth, and often projects so far as to wound and ulcerate the mucous membrane of the cheek or lip.

It sometimes happens, that after the first evacuation of the pus of an alveolar abscess the secretion becomes serous. I have known some instances in which the sac of the abscess has remained as a serous cyst even after the extraction of the tooth upon which it originally depended, the secretion recurring again and again after the cyst had been lanced. In one instance, where it had happened in a child in connection with an upper incisor tooth, I found it necessary to remove a portion of the wall of the cyst, when it granulated from the interior, and was obliterated.

The *diagnosis* of alveolar abscess is really very simple, though, as I have said, it is often mistaken for diseased bone in those examples where the orifice occurs on the surface of the face. The tooth is the equivalent in these case of a sequestrum; and it is, as far as the pulp-vitality goes, a dead organ. The fistulous canal leads to the dead tooth, as a sinus to the dead bone; thus far the two conditions are alike, and their appearances are alike; but there are obvious differences. In alveolar abscess there is general swelling, except at first in acute cases, and there is an absence of the diffuse indurated lymph-infiltration of the cellular tissue which is present in bone-necrosis; the canal leading to the abscess is single, usually short and direct, and not burrowing and complicated as in bone-disease;[1] moreover, there is generally an absence of fœtor in the discharge. The locality in a doubtful case, being the neighbourhood of the jaw, is in favour of the idea of a tooth being the cause; and an appeal to the state of the teeth seldom fails to settle the question definitely. Sometimes, however, a difficulty may arise from the fact that the cause of the abscess is a mere stump, overlapped by prominent gum; or, what occasions still more obscurity, the abscess may consist of a large excavated cavity in the substance of the jaw, into which the stump has fallen and become loose and free; or it may depend on an impacted tooth. A probe and the elevator will in either case complete the investigation.

While alveolar abscess, when connected with the integument of the face, is very apt to be mistaken by surgeons for diseased bone, the reverse has happened where a dentist has attributed to carious teeth morbid conditions which have been coincident with them, though not produced by them. I have known this occur in an instance where the patient was suffering from scrofulous caries of the malar bone near its suture with the superior maxilla—a mistake which led to the extraction of two slightly damaged teeth in no way connected with the disease. Again, I have seen one of the sub-maxillary lymphatic glands, rather adherent to the bone and in an early state of suppuration, mistaken for an outward-pointing alveolar abscess. Such errors as these, leading at most to the extraction of carious, though innocent, teeth, are trivial in comparison with those more frequent mistakes in which alveolar abscess is confounded with bone-disease, and an easily cured malady is allowed to run its course unrestrained, and permanently disfigure the face.

The *cause* of alveolar abscess is either caries of a tooth or death of the organ; the latter usually the result of mechanical violence, which has separated the pulp from its continuity with the subjacent nervous and vascular structures. It is uncommon to see the affection arise in association with sound and apparently uninjured teeth, though this sometimes occurs.

The *treatment* of alveolar abscess depends upon the stage at which the case is seen. In the earliest period, when suppuration is rather impending than established, the malady may be cut short by the extraction of the offending tooth, or by the removal of the stopping in a stopped tooth. Often it is undesirable to extract a particular tooth that may be threatening or causing the abscess; and in that case recourse should be had to leeching the gum freely, the administration of brisk purgatives, and abundant hot fomentation of the mouth. This mode of treatment, when it does not arrest the malady, much mitigates the attendant suffering. When matter has formed, and the wall of the abscess has sufficiently thinned, the pus should be evacuated by a puncture made through the gum with a narrow thin scalpel. This is followed by immediate and complete relief, and the general swelling associated with the advent of the attack rapidly subsides; but the disease, in the very great majority of cases, remains in the form of a continuously pus-discharging fistula. It is very rare indeed

[1] I once saw a very remarkable exception to the above, nearly universal, rule. A lady consulted me on account of a burrowing abscess, which first burst immediately below the lower jaw on the right side. This orifice closed and another formed lower down: this also closed, and was followed by another in the neck. The burrowing continued, and when I saw the patient, many months after the first discharge of pus, there were two sinuses opening about an inch *below* the right clavicle. A carious first lower molar had caused the suppuration, and its removal was followed by the immediate healing of the sinuses.

for the pus-secretion to cease : it may be so diminished that the external orifice may close for a time, but it is pretty sure to burst out again and again ; though I am confident (contrary to the general published opinion) that in a few exceptional instances the disease ceases altogether, the offending tooth still remaining in the mouth.

When an alveolar abscess shows symptoms indicative of external pointing, immediate and active treatment is necessary. The offending tooth should be taken out ; and in case it breaks in extracting, every vestige should be sought and removed. If matter has formed, and there has been decided thinning of the integument, showing its near approach to the surface, not only should the tooth be extracted, but a vertical incision should be made between the cheek and the jaw, so as to cut across the pus-containing canal ; else the matter is apt to *pocket*, and cause progressive absorption to the surface ; and though the tooth be removed, the abscess may thus still open externally. This vertical incision between the cheek and the jaw is also useful after the removal of a tooth, even when the external opening has occurred ; it cuts across the bands of lymph which glue the integument down to the bone : in this case a piece of oiled lint should be introduced and kept in the wound, to prevent the adhesion and reunion of the cut surfaces. In all cases of alveolar abscess, extraction of the diseased or dead tooth is *the* cure ; and I know but of two circumstances which peremptorily interdict this mode of treatment. First, where a strongly-pronounced hæmorrhagic diathesis forbids the extraction of teeth altogether ; and secondly, in those cases where the abscess is associated with the upper incisor teeth of young people in whom the jaws have not yet assumed their adult form, and where the permanent dentition is, as yet, incomplete. In this latter case it is of much importance to retain the teeth, even if reduced by decay to mere fangs, till the adult form of the jaws is established, even at great cost of suffering and discomfort. The earlier removal of the teeth would be followed by such contraction of the maxillary arch as would be incompatible with a proper replacement by artificial teeth of the natural ones missing.

II. *Painful and difficult eruption of wisdom-teeth.*—The advent of the wisdom-teeth is very often accompanied by painful and distressing symptoms, that may be protracted through many months, or even years, unless relieved by surgical interference. These circumstances arise from the position occupied by the wisdom-teeth, so close to the joint of the lower jaw, where the mucous membrane is reflected from the gum to the cheek and fauces, combined with the very common condition—that the jaw is not sufficiently elongated backwards to allow the dentes sapientiæ to range in the horizontal series with the other teeth. This mechanical difficulty not only prevents the proper evolution of the wisdom-teeth, holding them back in their bony bed, but it often perverts their direction of growth and dislocates them. Annoying and very painful as are often the symptoms attendant on difficult cutting and misplacement of the upper wisdom-teeth, they are trivial in comparison with those which occur in similar conditions of the lower.

The ordinary misplacement of the upper wise teeth is either backwards or outwards, or in both directions combined. When the tooth points backwards, every time the mouth is closed its crown comes in contact with the mucous membrane, passing up on the base of the coronoid process ; when the direction is outwards, which is more common, the tooth projects into the cheek, and when the jaws are brought together, a portion of the mucous membrane in this region is nipped and pinched. This is a very painful affair : the surface becomes ulcerated and extremely tender ; there is a partial cicatrisation, and the structure becomes stiff and hard as well as painful. Beyond this, however, the symptoms never (as I believe) extend, and the removal of the offending tooth is always followed by complete and immediate relief.

The difficulty which most commonly occurs with the inferior dens sapientiæ is attributable to insufficient room in the jaw : the tooth grows normally in direction and in position as regards its neighbour in front, but, from an imperfect lengthening of the horizontal ramus of the jaw, the birth of the crown is only partial and incomplete : the tooth is upright, but only its front cusps emerge, while the hinder cusps

are still covered in with gum, or even the upper wall of the bony loculus in which it was formed. This produces a terrible pinching of the mucous membrane over the tooth every time the jaws are brought together. Before, however, the enamel eminences of the tooth's crown make their appearance, the soft structures behind the second molar become much inflamed, and often suppurate, the pus-secretion appearing to be within the enamel sac of the tooth, between the tooth-crown and the membrane covering it. The inflammation, to which this impaction and pressure give rise, extends to surrounding tissues : the cheek and fauces suffer ; the movements of the jaw become stiff and painful ; and deglutition is difficult, and attended with suffering like 'sore-throat.'

Next in frequency to the foregoing malposition is that in which the wisdom-tooth is developed horizontally forwards, more or less. It is attended often with serious consequences. This direction is sometimes combined with an inward leaning ; and very rarely the crown of the tooth points outwards. This latter dislocation is very unusual ; but the most severe case of suffering from misplacement of the lower wisdom-tooth which I have ever seen was of this variety.

There is one peculiar symptom frequently associated with the painful cutting of a lower wisdom-tooth, which adds to the difficulty of investigating the condition of the parts, and still more interferes with the treatment : this symptom is *spasmodic contraction of the masseter muscle*, of a continuous and persistent character, the result of contiguous irritation ; not a spasm which varies in intensity, but a true *tonic* spasm, the muscles being permanently *set*, so as to keep the jaws nearly closed, and susceptible only of very slight separation. The jaw can usually be opened to a small extent, and then is definitely fixed ; it feels as if there were a mechanical obstacle to further movement ; but it is not so ; for when the cause of irritation is removed, the spasm rapidly ceases, and then the mouth can be fully opened. This same form of spasm sometimes occurs from caries of the molars, irrespective of crowding. The pain that accompanies and precedes the cutting of a wisdom-tooth varies very much in different individuals ; but it is frequently of a dull aching character, like rheumatism, for which it is occasionally mistaken ; it is diffuse and erratic, extending up the side of the head, and down to the shoulder. There is not unfrequently a good deal of swelling of the soft parts in the neighbourhood of the tooth, and this sometimes extends to the cheek and to the eyelids even, and below the angle of the jaw : the lymphatic glands beneath the jaw also occasionally become enlarged and tender.

The most distressing result, however, that occurs in these cases is the suppuration which sometimes attends the difficult eruption of the tooth. In slight cases, even where there is no misplacement or want of room, but simply a restrained progress, from an unusually dense or cartilaginous overlying gum, pus will be occasionally formed ; being secreted (as it has seemed to me) within the capsule of the tooth, by that which was the 'enamel pulp.' In severer cases, the pus burrows among the areolar tissue, around the periosteum of the jaw ; the neighbouring soft structures become infiltrated with lymph, and the integument is glued irregularly to the bone ; pus points at different spots, often remote from its original source ; and the whole cheek may be undermined with a series of sinuses. I have seen the side of the face, from the tragus of the ear and the angle of the jaw behind, to the angle of the mouth and mental foramen in front, a web of pus-discharging fistulæ, and which, after their cure (by the mere removal of an impacted wisdom-tooth), left the integument thin, and bound down to the bone, with the glossy, tense, cicatrix-like aspect of a recently-healed burn—a great and permanent disfigurement. While such cases are in activity, they have very much the appearance of necrosed bone. And, indeed, they do occasionally lead to necrosis of more or less of the jaw ; but the severest suffering and most suspicious symptoms may occur without such a complication. What is the precise anatomical condition of these burrowing suppurations I am not prepared to say positively. They are not apparently connected with the fang of the wisdom-tooth, like an alveolar abscess. I believe they commence in the enamel sac, before any portion of the crown pierces the gum ; and their subsequent course of burrowing is from the matter *pocketing* in a downward and onward progress. As long as any

part of the crown of the tooth is covered by gum, pus will be secreted by the under surface of the overlying portion. I have seen an impacted wisdom-tooth give rise to that form of serous cyst known as a 'dentigerous cyst.' In those instances where the crown of the wisdom-tooth projects forwards, the second molar very often suffers. The posterior fang is apt to be eroded by absorption, and the whole tooth may become necrosed; the first of these conditions is very common: I have met with several instances of it; in four specimens of lower second molars now before me, which were removed on account of forward pressure of wisdom-teeth, the posterior fangs are excavated by absorption in all; in two the pulp-cavity is closely approached; in two it is opened, and in one of the latter there was total necrosis of the whole tooth; the periosteum was completely stripped from both fangs, which were unattached in their sockets, and bathed in pus. These affections of the second molar should be taken into consideration in balancing the merits of the plans of treatment which may be contemplated in any particular case, and will, I think, favour that course of proceeding which I believe ought in many instances to be followed, but which is not now usually adopted.

Treatment.—The wisdom-tooth of the upper jaw, when misplaced, suggests but one mode of treatment; it by far the most often projects outwards; it is then useless for mastication; and if it pinches the cheek painfully on closing the mouth, it may be removed unhesitatingly and without compunction. The same may be said when it grows backwards and bruises the mucous membrane over the base of the coronoid process; the tooth is useless, and worse than useless, and should be extracted; it is very readily done, and, as far as I know, the annoyances attendant on the misplacement of the upper wisdom-tooth are never attended with that locked-jaw complication which so frequently attends the difficulties of the lower third molar eruption. In one rare instance, in which the upper wisdom-tooth grew forwards, it was found necessary to extract the second molar, on account of damage which it had occasioned by producing absorption of the neck of the anterior tooth.

In the treatment of these cases in the lower jaw, much will depend on the degree of impaction of the tooth; if it is simply covered over by a dense and cartilaginous gum, free lancing is all that may be required; but it will often have to be repeated. In young precocious people, who arrive very early at puberty, the wisdom-teeth often make their appearance before the jaw is ready for their reception, and are imbedded in the base of the coronoid process, though in a proper upright position. The age of the patient in such a condition is an important question; if young, lancing the gum freely, and waiting for further elongation of the jaw, and more horizontal accommodation, may be fairly and reasonably adopted: but the same state of things in an older patient is not so likely to find this relief; and if the suffering of the patient is great, extraction of the impacted tooth will become necessary. Where the tooth emerges tardily, and where the anterior cusps have come through the gum while the posterior have remained covered, I have found great advantage not only in lancing, but in cutting away the gum which overlies the back of the tooth, so as to lay bare the whole of the masticating surface of the crown. Merely lancing the gum affords much less relief, and the cut surfaces are apt to unite, and then present a harder and more resisting impediment. If the impaction is severe, and there is no chance, from the age of the patient, of sufficient accommodation, it will be necessary to extract a tooth, so as to relieve the crushing tension; and the question now arises as to which of the two, the second or third molar, should be extracted. *Cæteris paribus*, it is always better to sacrifice the third than the second molar: the wisdom-tooth is less useful for mastication, and is more liable to decay; it is altogether less robust: but the circumstances of the two teeth may not be equal or parallel—the second molar may be carious, or it may be loose or necrosed by the pressure of the tooth behind it: in either case I prefer extracting it to the wisdom-tooth. Again, the wisdom-tooth may be so situated that its extraction may be a physical impossibility, or nearly so, as is frequently the case where it grows horizontally forwards, deep down in the jaw. Another reason, the rigidity of the masseter spasm, may render it impossible to reach the tooth. In either case I should extract the second molar, though

perfectly sound, without hesitation. The distressing symptoms which are peculiar to the difficult eruption of the *lower* wisdom-tooth—the heavy pain, the sense of *tension* and *pressure*—are clearly dependent on the antagonism of the third and second molars; the former pushing forward into place, and the latter resisting its progress. The removal of the second molar puts an end to this antagonism as completely as that of the wisdom-tooth; and, in result, the one operation gives as entire and immediate relief as the other. When the second molar is extracted, the wisdom-tooth comes forward wonderfully; and an oblique or nearly horizontal tooth will advance in position, and alter in attitude, so as to become nearly, or quite, vertical, and a fair opponent to the upper second molar. In this improved position, when it can be used habitually in mastication, the dens sapientiæ is less liable to caries. But when suppuration has become established, every effort should be made to remove the wisdom-tooth itself, as the extraction of the second molar, under these circumstances, generally fails to arrest the discharge of pus.

The closure of the jaws is often so complete that, until this condition has been combated, it is impossible to get at either of the molar teeth. By pressing apart the jaws with some sort of wedge, this may be accomplished gradually, and in two or three days sufficiently to allow the removal of the tooth selected for extraction. Steel instruments have been devised on the principle of an ear speculum, composed of two shafts or blades, which separate slowly, but forcibly, by the action of a screw. I prefer a wedge of hard wood, such as beech or box-wood, which is pushed further and further into the mouth, as the contracted masseter yields before it. It seems to obliterate the spasmodic contraction for so much at each further introduction, and in a few days such an instrument will open the mouth sufficiently for tooth-extraction. Another arrangement, however, invented by Mr. Maunder, of the London Hospital, seems to possess advantages over those previously in use. It consists of a cone of box-wood or ivory, upon which is cut a spiral screw-worm, gradually increasing in diameter and in thickness of the worm; it resembles the shell of a univalve mollusc, such as a whelk-shell, only the spire is more elongated and drawn out. In cases where closure of the mouth is brought about by spasm induced through the painful eruption of a wisdom-tooth, occurring as it does in early life, the teeth in the front of the mouth are almost always firm, and would readily bear the wedging force. Upon introducing the point of Mr. Maunder's 'gag' between the incisors, or canines, or premolars, and slowly turning the instrument, it evenly and in regular progress separates the jaws, and, as I have thought, with quicker results than any other method. Very favourable results have been obtained with Coleman's gag, associated with anæsthetics.

In extracting an impacted wisdom-tooth one accident will occasionally arise; namely, the crushing of the inferior maxillary nerve beneath the tooth-fang. It is immediately attended by loss of feeling in the teeth and lower lip of that side. This has occurred twice to myself, In each case sensation slowly returned and was quite re-established in a few weeks.

III. *Tumours of the gum.*—(*a*) Epulis; (*b*) Congenital hypertrophy of the gum and alveolar borders of the maxillæ; (*c*) Polypus of the gum; (*d*) Vascular tumours; (*e*) Warty tumours of the gum.

Epulis.—The term "epulis" has been vaguely applied to various tumours that are found in and beneath the gums. The etymological meaning of the word (*ἐπί, upon, οὖλα, the gums*), entirely referring to position, and not to structure, is likely to have caused and to continue this confusion. Where, however, distinction has been drawn, it has been applied to those hard and densely fibrous tumours that arise from the surface of the alveolar processes, involving the periosteum, and by their expanded growth stretching the otherwise healthy gum over them. These are essentially different in origin, history, and anatomical structure from the loose flaps, and often pedunculated masses of gum, mere hypertrophied integument, that are not unfrequently seen in the neighbourhood of decayed teeth, and to which

the designations "polypus" and "fungus" of the gum have been appropriately given.'[1]

An epulis tumour consists of a hard dense mass growing slowly and evenly from the edge of the alveolar process usually between two standing teeth, and more commonly on the labial or buccal aspect than the lingual. The point at which this growth generally makes its first appearance is beneath and involving the little tongue of gum which exists between the necks of two contiguous teeth. As it progresses in size, it displaces the neighbouring teeth, one usually more than the other; it has for the most part a broad base, and increases in basal area more than in projecting growth. The situation in which an epulis commences is liable to a good deal of variety; though usually at the free edge of the alveolar process, it may form at a distance from it; but I believe it is always associated with porous vascular bone, nearly connected with the periodontal membrane, and does not spring from the compact tissue limiting the outline of the bone. The growth sometimes commences *in* the tooth-socket. As I have remarked, the *endosteal* membrane shares in the genesis of an epulis tumour, and the fibrous growth appears to burrow, so to speak, into the substance of the bone, producing a general expansion of the whole structure. The surface of the tumour is like that of the surrounding gum; it is, however, sometimes mottled, and not infrequently slightly but broadly and flatly lobulated. It is as insensitive as the surrounding gum, and is not liable to bleed; when manipulated, it is tense and elastic. The tumour varies in size indefinitely—from the size of a pea to that of a walnut, or larger. It is generally stated that epulis tumours are more common in the upper than in the lower jaw: this coincides with my own experience. I happen to have met with them in the proportion exactly of two of the former to one of the latter. According, however, to Mr. Heath's table, he has met with twelve cases of epulis in the lower jaw to nine in the upper. The epulis tumour appears to have a certain relation to the teeth in whose neighbourhood it forms. It almost always makes its appearance where there *are* teeth: it usually invades one in a very marked degree more than any other near which it may be situated, by dislocating it and pushing it out of place: it has nothing to do apparently with caries of the tooth: the removal of the particular tooth, with excision of the tumour, is generally accompanied by immediate and complete cure of the disease.

Occasionally these tumours appear where teeth have been removed and the gum seems to be edentulous; it will, however, generally be found in these instances that a fang of one of the teeth has been left behind, and is associated with the irritation that has caused the morbid growth. One of the most severe examples of this malady which I have seen consisted of a bilobular mass, the size of a large walnut, extending, on the left side of the lower jaw, from the dens sapientiæ to the canine tooth, the four intermediate teeth having been removed. The excision of the tumour had been repeatedly performed, but it always returned. Its removal on this occasion disclosed the remains of one fang of the first molar tooth in its very axis; this was extracted, and the disease did not again make its appearance. I believe this will generally be found the case where the tumour forms upon an apparently edentulous region of the jaw. Epulis has its origin in the osteal membrane of the alveolus. The bone of the alveolar processes is very vascular, and almost cancellated in its loose open structure. The endosteal membrane which lines this cancellated bone, the periosteum which covers it, and which lines the tooth-sockets and the fibrous tissue of the gum, are all continuous, and alike share in the development of an epulis tumour. The bulk of the tumour consists of a dense web of fibrous tissue; and from its basal attachment, and passing into its substance, are usually small growths of bone. The fibrous tissue interlaces pretty regularly—some fibres being parallel to the surface, and others radiating from the base, intersecting the former at right angles. The bone-growths may be thin needle-like spicula or little flakes: at the point whence these bony processes arise, the tumour receives its main vascular supply, and the subjacent bone is very porous. Mr. Cæsar Hawkins mentions an instance

[1] *Specimens of Epulis*, by S. J. A. Salter, *Trans. Path. Soc.* vol. v. 1854.

of an epulis attached only by a pedicle to the gum, in which there was a nucleus of bone. This could not at any time have had bony union with the jaw; but the circumstance indicates, in a physiological sense, the osteal character of these fibroid developments. Epulis tumours are perfectly innocent, nor do they, I believe, ever pass into a malignant character. Sometimes, though rarely, they ulcerate on the surface; but this is only under the influence of external agencies, such as produce ulceration of any portion of the gum: they may then become painful.

The histology of epulis tumours is consistent with their history—locally recurrent as long as the circumstances under which they occurred are maintained, destroyed by the removal of their local nidus, and never impregnating the system. Epulis tumours are always, I believe, a form of 'fibro-plastic;' a combination of fibrous tissue and myeloid cells, the proportion of the two constituents varying indefinitely. In general, the main bulk of the tumour consists of fibrous tissue; but sometimes the myeloid-cell element preponderates, and may form the major portion of the growth.[1] According to Mr. Heath, the myeloid form preponderates in the lower jaw and the fibrous in the upper.

The *treatment* of epulis is very simple; it requires early and complete extirpation with the knife, and according to the extent and inveteracy of the case it may also need the removal of contiguous teeth and subjacent bone. These latter circumstances refer to an important circumstance in the *pathological history* of the disease: it is this, that as long as the alveolar process remains upon which the tumour grew, and which must necessarily be as long as the teeth which are implanted in it are not removed, so long will the tumour be inveterate, so often will it return, however accurately and carefully it may have been removed. Such, at least, is the very general rule. But when the alveolar process is gone, it shows no tendency to return. And it is a remarkable circumstance, that the spontaneous absorption of the alveoli that follows the extraction of the teeth is of itself, *in many instances*, where the disease is confined only to these processes, enough to prevent its recurrence. That is to say, if the tumour be removed to a level with the gum, and the contiguous teeth be extracted, the alveolar process vanishes, by absorption, and the disease no more returns; though the same operation, without the removal of the teeth, may have been performed unsuccessfully any number of times previously. In a first operation when the disease is of limited extent, it will be well to try the result of its simple removal by the scalpel without the extraction of teeth or the cutting away of more bone than can be accomplished with the knife. The bone about the base and axis of the tumour being vascular and spongy, the knife readily cuts away small portions. Any subsequent sprouting of granulations in an undue or threatening degree should be checked and repressed by some caustic, and for this purpose nitric acid has been especially recommended. If the disease recurs, as it too often does, the same operation should be repeated, and accompanied by the extraction of a tooth or teeth whose socket or sockets have been implicated. Unless the disease have a deep hold on the bony substance of the jaw, it will seldom be necessary to cut away any large amount of bone; sometimes, however, this is the case; or the growth may have started deep in the socket of a tooth. In such an instance, it may be necessary to extirpate a considerable amount of bone. A V-shaped portion or a cubical mass may be readily cut out by means of a Hey's saw and bone-nippers, according to the form and extent of the particular tumour. It will never, I believe, be necessary to go far below the limit of the alveolar process; for it is with the alveolar bone that the disease is essentially connected. In the lower jaw I would urge the necessity of never cutting through the entire bone, as the breaking of the maxillary arch most seriously interferes with the position of the remaining portions of the bone, and thus disturbs the normal opposition of the teeth in the two jaws relatively.

Congenital hypertrophy of the gum and alveolar borders of the maxillæ.—In 1859 I had an opportunity of seeing a very remarkable example of disease, which is, perhaps, best defined by the above title, under the care of Mr. Pollock, at St. George's

[1] *Specimens of Epulis*, by S. J. A. Salter, *loc. cit.*; 'Myeloid Epulis of Lower Jaw,' by J. Hutchinson, *Trans. Path. Soc.* vol. viii.

Hospital. At that time there was, I believe, no recorded example of this curious tumour-like growth; nor had any instance of it been published as far as I am aware, until a case was described and figured by Gross in the second edition of his 'System of Surgery.'[1] This case was not only the same in essence, but was singularly like Mr. Pollock's in all particulars.

Similar cases have since been recorded. One occurred in University College Hospital under the care of Mr. Erichsen, and is described by Mr. Heath.[2] Another is published by Mr. Waterman,[3] an American surgeon. Three examples have been recorded by Dr. Murray,[4] and two more recently by Mr. Heath.[5]

Mr. Pollock's patient at the time of her admission into the hospital was eight years old. At birth nothing was noticed unusual in her mouth, but a fortnight after a tooth was cut, and by the fifth week six had appeared. It was then remarked that the gums were full and thick, and puffy. They continued to increase in bulk, and at two years of age they were cauterised, and all the temporary teeth which had appeared were extracted. At birth the child had an unusual quantity of hair on the head, and also much on the arms and legs: when taken into the hospital this peculiarity was very striking; the hair of the head was coarse and rank, and grew low on the forehead, and in front of the ears on to the cheeks. The arms and legs were covered with hair. The patient was epileptic.

Before any operation was performed, the girl presented a most extraordinary appearance. A large mass, pink and smooth, protruded from the mouth, which the lips did not and could not cover. It was slightly corrugated or indistinctly lobed; the structure was very dense, inelastic, and insensitive, and appeared skin-like on the surface. The greater bulk proceeded from the upper jaw, and was most developed in the front of the mouth; but the same condition appeared along the whole edge of both jaws, that of the lower jaw being less, and covered and overlapped by the upper.

In structure this hypertrophied mass consisted both of an expanded and prolonged development of the alveolar borders of the maxillæ, and an immense thickening of the fibrous tissue of the gum, with a proportionately exuberant growth of the papillary surface. The removal of portions of the mass by surgical operation gave opportunities of examining its precise nature. In the front of the upper jaw, where the development was greatest, the fibrous mass extended in some places more than three-quarters of an inch beyond the alveolar edge, which it thus covered in with a dense cushion. Those of the temporary teeth which had not been extracted were deeply embedded in the mass, the crowns of the second lower temporary molars being the only ones which were now visible. The crowns of all four of the six-years' old teeth (first permanent molars) had appeared on account of the slightness of the hypertrophy towards the back of the mouth. A section of parts of the removed mass displayed the remaining temporary teeth completely clothed with the thick fibrous growth, the fangs embedded in sockets, but the crowns free of bone and each closely surrounded by a serous-like chamber without any communication with the surface. One of the superior central incisors was more deeply covered than any other teeth, and was nearly an inch from the surface. The fangs of the permanent teeth were developed in accordance with the age of the patient; but I observed that the crowns were still encased in the *bony* loculi, though from the age of the patient the distal wall of the bony capsules should, in many of them (incisors and first premolars), have been absorbed. In the socket of the first temporary incisors a small absorbed orifice existed, leading into the loculus of the permanent tooth, such as is usually found about five years old.

But the most remarkable point of structure in this growth was the papillary surface. The epithelium had changed into a very thick and hard epidermis, beneath which, and evenly covered in by it, were enormously long papillæ. The papillæ of gum vary from about $\frac{1}{75}$th to $\frac{1}{35}$th of an inch in length normally; but in a section, vertical to the surface, they here appear from $\frac{1}{6}$th to $\frac{1}{4}$th of an inch; and when by maceration the outer epiderm has been removed, the papillæ stand up like the pile of plush or velvet, and may be brushed from side to side by the finger. Kölliker[6] has noticed that in the mouths of edentulous old people, whose bare gums are exposed to the rough attrition of food, the papillæ become much enlarged and elongated, attaining sometimes the $\frac{1}{16}$th of an inch in length: and here, under exposure to still more physical violence, the same change has taken place to a vastly greater degree. But I apprehend that this monstrous development of the papillæ has also another meaning, and that it is an essential element of the disease; it is quite in keeping with the

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[1] *A System of Surgery*, &c., by S. D. Gross, M.D.; Philadelphia, 1862. 2nd edition, vol. ii. p. 535, fig. 330.

[2] *Injuries and Diseases of the Jaws*, p. 189. London, 1868.

[3] *Boston Medical and Surgical Journal*, April 8, 1869, p. 167.

[4] *Med.-Chir. Trans.* vol. lvi. p. 235. 1873.

[5] *Trans. Odont. Soc.* vol. xi. p. 18. 1879.

[6] *Mikroskopische Anatomie, &c.*, von Dr. A. Kölliker, vol. ii. p. 85. Leipsic, 1854.

rough and thick skin of the patient, the abundant development of coarse hair over the surface, and also the enormous teeth. The permanent teeth which were removed by the operations are excessively large, especially the superior central incisors; these are larger than any I have before seen removed from a female mouth. All these circumstances imply a tendency to a general tegumentary and papillary hypertrophy.

Treatment.—The proper treatment of this disease is obviously that which was followed in each of the recorded cases. Portions of the projecting mass were cut away with scalpels and bone-nippers till the alveolar borders were curtailed to within moderate limits. The operation was not completed at once, but was performed in detail, as the patients could bear it. In Mr. Pollock's and Dr. Gross's cases there was a slight tendency to a fresh growth where the hypertrophied masses were removed.

Polypus of the gum.—The gum is liable to a simple hypertrophy, the increase of growth—a sort of mucous tubercle—being confined to the gum structure alone, and not involving the osteal membrane, nor complicated with a growth of bone. The little tongues of gum between the necks of the teeth are liable to this affection, especially towards the front of the mouth; and they sometimes grow to such an extent, being confluent with those on either side, as to cover a considerable portion of the crowns of the teeth. This condition is usually associated with uncleanly habits; and may be generally cured and prevented hereafter by simple and easy means. The teeth should be thoroughly cleansed from tartar; the gums may be scarified: for the future the teeth should be abundantly brushed with a stiff brush, and the mouth washed with an astringent lotion, of which solution of permanganate of potass may form an ingredient. I have seen a modification of this condition, which was evidently syphilitic; the growths of the gum were *condylomatous*, and were more or less covered with very painful superficial ulcers. The symptoms readily yielded to the internal administration of iodide of potassium and the application with a camel's-hair brush of a solution of nitrate of silver, 10 grs. to ℥j. aquæ. Hypertrophy of the gum of a truly polypus-like form not infrequently occurs in the immediate neighbourhood of teeth which are carious at their sides, and when the caries reaches the neck of the tooth: the irritation of the contiguous dentinal disease seems to stimulate this unwonted growth, and the mucous membrane bulges into the cavity and fills it up. The cavities of two teeth carious on their contiguous surfaces are very apt to be associated with this condition, the little polypus of gum between them rising to their masticating surfaces. Such tumours are more or less pedunculated; they have a red fleshy look, and are very liable to bleed when roughly touched. The structure of these growths is in consonance with their aspect and the ease with which they bleed; they consist principally of hypertrophy of the true mucous-membrane element of the gum, especially the papillary structure: the epithelial covering is rather diminished in proportional amount, while the papillæ themselves become enormously elongated and increased in diameter, and some of the conical papillæ develop into the compound fungiform variety. These changes are accompanied by great dilatation of the capillaries which loop into the papillæ.

Polypous growths of the gum are so often dependent on the state of the contiguous teeth, that their treatment involves that of the teeth also. If the polypus, growing into a carious tooth, is extirpated, it will most probably return till the tooth itself is removed, or the condition of the tooth which had irritated the gum has been remedied. The caries should be cut away; ragged or sharp edges of tooth-substance should be smoothed and blunted, and the remaining cavity should be filled. The gum may still show some tendency to renewed sprouting, and this may be kept down for a time by the repeated application of a strong solution of nitrate of silver, sulphate of copper, or alum, when it will probably assume a healthy aspect. If the removal of the polypus is accompanied by the extraction of the offending tooth, I believe it never returns.

Vascular tumours.—The tissues about the necks of the teeth are obnoxious to the growth of vascular tumours, which vary from passive *nævus-like* swellings to those other forms of more arterial character—*aneurisms by anastomosis.* I have met with

both these forms of the disease. The most common position in which it develops itself is in front of the upper jaw, between the incisors, or canines and lateral incisors. A rather severe instance which occurred recently under my care manifested itself in the region that should have been occupied by the left lateral incisor of the upper jaw; but as the laterals were wanting in this person, the tumour formed between the canine and central incisor. It had been about six months in reaching its then size, the dimensions of a large marble flattened on the surface. It was of a purplish colour, streaked with many vessels on the surface; it was easily compressed, but was elastic, and when pressed it became pale, exsanguine, and much reduced in size; upon removing the pressure it resumed its previous aspect in a pulse or two. The surface of the growth was tolerably smooth; the base somewhat constricted, being about one-third less than the head of the tumour. The whole of the gums were very red, turgid, and swollen, and the little tongues of gum between the necks of the teeth generally were enlarged and spongy. The patient had suffered no pain, but was conscious of a constant throbbing and pulsation. The most important symptom, however, was the hæmorrhage, which had latterly become a serious source of trouble and distress; it usually occurred at night; it would ooze from the mouth and stain the pillow and sheets, and sometimes trickle into the glottis and cause momentary suffocation.

The treatment which I first adopted in this case was determined by the very *arterial* character of the tumour. I attempted to destroy it by ligature: a needle armed with a double thread was passed through its base, and each portion of the thread was tied so as to strangulate half of its attachment. The ligatures were tied tight, but did not cut through the substance of the growth. Their effect was for the time to produce complete strangulation: the tumour was tense; and the blood could not be squeezed out of it by pressure. This plan did not ultimately succeed, for the size was not permanently diminished and the circulation was re-established. I next removed the tumour by a very tight ligature, cutting it clean off; after this it returned as before, and I finally extirpated it with a scalpel, cutting freely inwards so as to remove a portion of the spongy vascular bone which seemed to form its basal axis. The bone at the base of these growths appears always to be very vascular and open in its texture. Considerable hæmorrhage followed the operation, which ceased under cold and pressure. For a few weeks the cicatrix furnished freely sprouting granulations; these were abundantly cauterised twice a week, and ultimately yielded a healthy scar. In structure this little mass when removed displayed a complicated vascular network, which, under the action of acetic acid, with the microscope, exhibited little else than an elaborate aggregation of the nuclei of blood-vessel muscle-cells. The surface was clothed with epithelium and papillæ, like the gum. I believe that no danger can arise in these cases from the use of the knife in at once extirpating the tumour; the bleeding may be profuse for a minute or two, but it soon ceases.

I have seen a vascular tumour connected apparently with the periosteum of a loose molar tooth, in which the hæmorrhage was very severe, occurring also at night to an extent that was really alarming: the tumour was a tense pedunculated mass, attached to the side of an upper molar tooth, half of the fang of which was naked. The extraction of the tooth brought away the tumour with it, which immediately shrivelled up to half its previous volume, and became soft and flabby.[1]

These tumours, as far as I have observed, occur in adult and middle life; they are perfectly innocent, and show no tendency to return when carefully eradicated.

Warty, or papillary tumours of the gum.—The papillæ of the gum occasionally become hypertrophied into warty growths. A singular instance occurred in the practice of Sir William Fergusson, in which the papillæ were more than half an inch in length: they were soft and shreddy, and consisted mainly of loosely adherent epithelium. The tumour was removed, and recurred several times. Another

[1] 'Vascular Tumours connected with the Dental Periosteum,' by S. J. A Salter; *Trans. Path. Soc.* vol. v. 1854.

example was operated on by Mr. Cock, at Guy's Hospital, in which a warty tumour, the size of a split chestnut, formed in the hard palate of a man.[1] This was covered with papillæ the eighth of an inch long. It consisted principally of fibrous tissue and dense coherent epithelium. I have seen a profusion of small warts on the gums associated with warts on the lips and about the face. In all cases the growths should be removed with the knife; and any recurrence should be repressed by caustic or astringent applications.

IV. *Tumours of the pulp. Polypus of the pulp.*—In carious teeth the tooth-pulp is occasionally developed into a polypus-like growth, that fills more or less the diseased cavity. This formation is a dense, gristly, pink-coloured mass, consisting of a modification of the original dentine-forming organ: it is always attached by a constricted base to the pulp in the canal of one or more of the fangs; the mass itself is usually more or less rounded, frequently corresponding in form exactly to the carious cavity which contains it; sometimes, by a more exuberant growth, it is forced into a polyhedral shape by the contiguous structures, whose pressure curtails its further enlargement—the masticating surface of the opposing tooth in the other jaw, the distal and proximal neighbours of the tooth from which it has sprung, the tongue and the cheek; such cases as these usually occurring where the walls of the original tooth have completely broken away, leaving a distinct interval bounded by the parts I have named. In such examples it may be difficult to an inexperienced observer to make out the nature of the tumour; it may be mistaken for an *epulis*, or a gum polypus; search for the remains of the decayed tooth will settle this doubt. This polypus is very callous and insensitive to pain; it is not liable to ulcerate or bleed; but it discharges pus from its surface, especially when in contact with the walls of the carious tooth in whose cavity it forms. In structure these polypi approach, in the majority of instances, very closely to the ordinary granulations of a healing sore, consisting superficially of a mass of exudation corpuscles, through which are distributed multitudes of capillary loops, and more deeply of a fibrous tissue into which these cells have developed. In these instances the most superficial cells appear to be shed, assuming the form and aspect of pus. Rarely these granulations seem to heal, to cicatrise; and I have found a few instances in which the surface of the polypus has been clothed with a dense cuticular epithelium overlying a basement membrane folded into true papillæ. Polypus of the tooth-pulp 'most often occurs in young people, and in those in whom the teeth are imperfectly calcified, presenting that peculiar globular calcification in which the substance of the dentine becomes rapidly sodden with saliva, and carious without limit from the enamel to the pulp.' 'The physiological phenomena displayed by polypus of the pulp are very remarkable as regards both the pulp itself and the tooth—their oppositeness to the whole train of circumstances which accompany the ordinary inflammation of the pulps dependent on caries, odontalgia, lymph-deposit on fangs, alveolar abscess, &c. . . . The pulp never undergoes intrinsic calcification, nor have we any evidence that dentine of repair is ever formed.'[2] Occasionally, though very rarely, teeth with polypus of the pulp produce alveolar abscess.

The treatment of this condition is very simple. If the polypus is cut away, it will certainly return; caustics and the like applications appear to have no influence in repressing it. If the tooth be extracted, it is finally eradicated; and this plan should in my opinion always be adopted.[3]

Sensitive growth of pulp after fracture.—This condition only occurs, as I believe, when a tooth with a healthy pulp is suddenly fractured by mechanical violence. When a pulp is thus exposed, it exhibits intense sensitiveness to touch, to cold or

[1] 'Papillary Tumours of the Gum,' by S. J. A. Salter, in *Guy's Hospital Reports*, 3rd series, vol. xii. p. 358.

[2] 'Polypus of Tooth-pulp,' by S. J. A. Salter, *Guy's Hospital Reports*, 3rd series, vol. iv. 1858.

[3] I learn from Mr. Coleman that he has once succeeded in saving the tooth by excising the growth, touching the pedicle with strong nitric acid, capping, and filling the cavity with stopping.

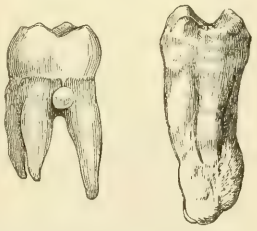
heat, or indeed to any external influence; and it frequently sprouts into a small excrescence. This excrescence is usually of a semi-transparent aspect; it is often complicated on the surface, and villus-like: when removed, like the other form of pulp-growth, it certainly returns, and of the same character as before. In microscopic structure this sprouting of the pulp differs little from the insensitive polypus; but its vitality implies a more abundant nervous supply—vascular granulations appear to the observer to constitute its histological elements. This condition remains as a permanent torture to the patient, till the tooth is extracted, when it is of course completely removed. I have known this state of tooth-pulp form a very distressing complication in a case of fracture of the lower jaw, in which a bicuspid tooth was broken and the pulp exposed: here the apparatus for fixing the displaced bone, and the introduction into the mouth of food, were attended with agonising pain, which continued till its source, a fractured tooth with a quick pulp, was discovered and extracted. Afterwards the treatment of this fracture was successfully and painlessly prosecuted. The possibility, indeed occasionally probability, of such complication, in treating fractures of the maxillæ, should be borne in mind by surgeons; and it should be especially remembered, that when extreme sensitiveness and pain manifest themselves in such cases, a fractured tooth should be sought for.

V. *Tooth-tumours: odontomes.*—The hard tissues of teeth are sometimes developed into tumours, which may be divided as follows:—

(*a*) Enamel nodules, or submerged cusps on tooth-fangs.
(*b*) Exostosis.
(*c*) Hypertrophied, dilated fangs.
(*d*) Dentine excrescence.
(*e*) Warty teeth.

Enamel nodules are sometimes seen on the fangs of teeth, forming little pearl-like tumours: they are essentially *submerged cusps*, each consisting of a little cone of dentine, covered by a thick tubercle of enamel, which is clothed by a true enamel-pulp.[1] These tumours are not known to occasion any symptoms; and are rather of physiological than surgical interest: indeed they are alluded to here, simply to complete the list of tooth-tumours.

Fig. 109. Fig. 110.



The accompanying illustration (fig. 109) is taken from a characteristic specimen.

Exostosis on the fangs of teeth is sometimes a serious malady. An increased development of crusta petrosa may occur upon the fang of a tooth as the secondary result of other disease in the tooth—usually caries; or it may arise spontaneously—the tooth being entirely free from other abnormal change.

In the former case the thickening of the fang is usually general, around its circumference and principally on its lower third, as repeated in fig. 110. The symptoms of this condition are scarcely to be distinguished or separated from those of the tooth-disease with which it is associated.

Where the disease arises spontaneously it is apt to produce the most distressing neuralgic affections. The teeth appear sound, but they become sensitive to change of temperature and even to the touch: they elongate from the sockets and spread; with this there is more or less neuralgia of the trigeminus, or one of its terminal branches. Then one particular tooth becomes more distinctly affected than the others: all the pain seems to emanate from it: and each flash of neuralgic agony seems to start from it alone. At length the tooth is extracted and relief follows. Then usually another tooth becomes affected and requires removal: and this may, in very severe cases, go on till all the teeth in one jaw, or even in both, have been

[1] For the structure of these growths, see 'On Two Forms of Tooth-tumours,' by S. J. A. Salter, in *Guy's Hospital Reports*, 3rd series, vol. xiv. 1869.

extracted before complete and permanent relief is obtained.[1] In these cases the exostosis usually consists of small nodules with rounded surfaces situated near the apex of the fang. Such forms of exostosis may, however, exist without producing any apparent symptoms whatever. Fig. 111 represents a magnified section of the fang of a tooth in which this nodular form of exostosis existed.

Exostosis on the fangs of teeth consists solely of an hypertrophy of the crusta petrosa, or tooth bone, the outer layer of the fang. It is usually solid and compact in structure: though very rarely it is cancellated and vascular.[2]

Hypertrophied, dilated fangs.—This title best defines the nature of a very rare form of tooth-tumour, of which I believe there are only four recorded examples. One of these occurred in the practice of M. Maisonneuve and is described by M. Forget;[3] another occurred to Mr. Hare of Limerick, and is described by Mr. Tomes;[4] another is described by Heider and Wedl;[5] and a fourth is a specimen in the Museum of the College of Surgeons of England (Preparation 1022) which has been histologically examined and described by myself.[6] The latter is supposed to have been in the collection of John Hunter. The first two of these examples were mistaken for exostoses.

These tumours consist of dilatations of the fangs of the teeth; the dentine-pulp being hypertrophied into a globular mass of considerable size; and, when calcified, producing a bone-like mass, generally larger than the tooth itself. In structure

Fig. 111. Fig. 112. Fig. 113.

these tumours consist of an outer layer of tooth-bone; then a thin shell of true dentine, enclosing the gigantic pulp, which may or may not be calcified. In the former case, this bulky nucleus of the tumour consists of a mass of osteo-dentine.

In the only two cases in which the symptoms were recorded, there was pain with expansion of the jaw at the alveolar portion. In Mr. Hare's case there was a fistulous communication from the tumour through the jaw opening on the cheek. This discharged pus.

In each case the extraction of the tooth brought away the tumour also: the swelling subsided, and the patient recovered completely. Fig. 112 represents the specimen in the Museum of the College of Surgeons.

Dentine excrescence.—Nodules of secondary dentine growing from the wall of the pulp-chamber into its cavity in teeth otherwise apparently healthy, are sometimes seen, though they have not generally been associated (perhaps from imperfect observation) with any definite symptoms. The accompanying illustration (fig. 113), however, represents an example[7] where the little tumour evidently produced

[1] See a striking case illustrative of this condition, published by the author, in *Guy's Hospital Reports*, 3rd series, vol. xiii. p. 86. 1867.

[2] 'Vascular Exostosis,' by S. J. A. Salter, in *Path. Trans.* vol. vi. p. 168. Pl. viii. figs. 3 and 4. 1855.

[3] *Des Anomalies dentaires, et de leur influence sur la production des maladies des Os maxillaires*, par M. Forget. Paris, 1869. Obs. iii. p. 27, Pl. ii. figs. 1 and 2.

[4] *Transactions of Odontological Society of Great Britain*, vol. iii. p. 335. 1863.

[5] *Atlas zur Pathologie der Zähne*, bearbeitet von weil. Prof. Dr. M. Heider und Prof. Dr. C. Wedl, p. 3, fig. 28. Leipzig, Nov. 1868.

[6] *Guy's Hospital Reports*, 3rd series, vol. xiv. p. 463. 1869.

[7] 'Dentine Excrescence within the pulp-cavity of the Incisor Tooth,' by S. J. A. Salter, *Path. Trans.* vol. vi. p. 164, fig. 1. 1855.

neuralgia, of a character very similar to that occasioned by exostoses on the fangs of teeth. The tooth was a superior central incisor, which was constantly painful: the slightest touch or change in temperature augmented the pain considerably, when it often flashed over the face and nerves of that side of the head with great severity. The extraction of the tooth, which was for the moment attended with a violent paroxysm of neuralgia, completely removed all subsequent pain. The dentine-excrescence was the only abnormal condition which the tooth presented. Its pressure upon the nerves of the pulp would readily explain the symptoms of the case.

This anatomical condition is not altogether uncommon, but it seldom causes painful symptoms.

Warty teeth.—These are among the rarest and most important of the tooth-tumours. They consist of teeth in which the tissues are hypertrophied and folded into an irregular and complicated mass. The warty condition may affect part of the crown of a tooth; or all the parts of the tooth may be involved; or the irregular mass may consist of teeth blended together.

M. Broca, in a general résumé [1] of this subject, which he read before the Academy of Sciences of Paris (December 30, 1867), divides warty teeth into 'circumscribed dentinal odontomes,' and 'diffuse dentinal odontomes;' the former being those examples in which the warty mass occupies a portion of the tooth only; the latter, in which the whole tooth is implicated, and its anatomical form is no longer recognisable.

Warty teeth are rare, and I am only acquainted with twelve recorded examples —six of the circumscribed variety and six of the diffuse. Of the former, four were described by myself,[2] one by Mr. Tomes,[3] and one by Forget;[4] of the latter, two were recorded by Oudet [5] (in the same individual), one by Wedl,[6] one by Mr. Tomes,[7] one by Forget,[8] and another by Mr. Harrison.[9]

Fig. 114.

In the cases recorded by myself, one was a superior lateral incisor with a warty mass, the size of half a horse-bean, projecting from the front of the neck of the tooth. A section of this tooth for the microscope is in my histological collection. A second case, which occurred in my own practice, was that of a right lower dens sapientiæ. The mass, about the size of a small bean, sprouted from the posterior aspect of the neck of the tooth. My two remaining examples are specimens in the Museum of Guy's Hospital: one a lateral incisor, and the other a wise-tooth, both of the upper jaw: from the side of each tooth a warty mass projected. The accompanying illustration (fig. 114) represents the lateral incisor referred to.

Mr. Tomes's specimen was a superior central incisor: the wart occupied the whole of the front of the crown of the tooth. In Forget's example, the first and second lower molars were blended into one: the crowns constituting a large confused wart-like body, while the fangs were normal. This is shown in fig. 115.

[1] *Recherches sur un nouveau groupe de Tumeurs désigné sous le nom d'Odontomes*, par M. P. Broca. *Comptes-rendus des Séances de l'Académie des Sciences*, tome lxv. p. 1117. Paris, 1867. Also in *Gazette médicale de Paris*, No. 2, Jan. 11, 1868.

[2] 'Description of a Warty Tooth,' by S. J. A. Salter, in *Trans. Path. Soc.* vol. vi. p. 173; London, 1855. 'Contributions to Dental Pathology: On Warty Teeth,' by S. J. A. Salter, in *Guy's Hospital Reports*, vol. iv. 3rd series; London, 1858. Same title, vol. v. 3rd series; London, 1859.

[3] *A System of Dental Surgery*, by John Tomes, F.R.S., p. 226. London, 1859.

[4] *Des Anomalies dentaires et de leur influence sur la production des maladies des Os maxillaires*, par M. Forget, p. 25. Paris, 1859.

[5] 'Cas d'exostoses sur des dents devenues monstrueuses,' par M. Oudet, in *Nouveau Journal de Médecine*, p. 245. Paris, 1821.

[6] *Grundzüge der pathologischen Histologie*, von Carl Wedl, p. 626. Wien, 1854. A further description of this specimen is published in Heider and Wedl's *Atlas zur Pathologie der Zähne*, part i. fig. 39.

[7] In Tomes's *System of Dental Surgery*, p. 225. London, 1859.

[8] *Loc. cit.* p. 5.

[9] *British Journal of Dental Science*, vol. v. p. 557. London, 1862.

The diffuse forms of warty teeth, which have produced large cumbrous tumours, have all been developed in the lower jaw. They deserve more serious consideration.

In Oudet's case a man, twenty-five years of age, exhibited in his lower jaw two hard bony tumours, occupying the premolar region one on each side. They were encrusted with salivary calculus, upon the removal of which an irregular coating of enamel was displayed, folded into shapes like cusps and tooth-edges. These masses were evidently formed from the fused and hypertrophied germs of the two premolar teeth on both sides of the jaw. The right was removed rather easily by tooth-instruments, but the patient declined to have the other interfered with.

In Wedl's case the whole of the second lower molar tooth of the right side was developed as a large complicated mass in which the several tissues of the teeth were confounded together. It was overlying and keeping down the wisdom-tooth. With a pair of forceps it was removed without much difficulty.

The specimen described by Mr. Tomes is exactly the same as the foregoing. It consisted of a confused mass of dental tissues as large as a chestnut, representing the second lower molar tooth, beneath which was buried the wisdom-tooth. It occurred many years ago in the practice of Sir William Fergusson, who excised the angle of the jaw for its removal.

But M. Forget's is the most serious recorded example of this malformation. Here an enormous tumour, as large as a turkey's egg, occupied the whole of the molar region of the

Fig. 115.

Fig. 116.

left side of the lower jaw. It represented two molar teeth with their tissues blended together in utter confusion and into a shapeless mass. Beneath it was a third molar tolerably well formed. The jaw began to expand in early childhood, and continued to do so till the patient attained the age of twenty, when M. Forget removed the angle of the jaw, including the tumour. The mass was covered by gum, excepting for a space on its surface the size of a sixpence. There was some pain at times: the submaxillary glands were enlarged, and several fistulous pus-discharging canals led to the base of the tumour. The acccompanying illustration (fig. 116) is from Forget's memoir, and displays a section of the tumour *in situ*.

Mr. Harrison's specimen represented the two bicuspids and canine of the left side on the lower jaw. The tissues were confounded together, and without any resemblance to tooth-form. It loosened and came away by itself.

As regards the treatment of these cases, much depends on the degree of the malformation. If it is only partial and a matter of appearance, the tooth may be removed and replaced by a better-shaped artificial representative, according to the wishes of the patient. But should the growth be of a large size and interfere with the action of the mouth, it should certainly be extirpated; and this, in nearly all instances, might be accomplished by extraction with forceps; or, at all events, without serious damage to the jaw.

VI. '*Abscess*' *of the antrum.*—The term *abscess* of the antrum conveys a very wrong impression of the real nature of this disease; it is not the suppuration of inflamed parenchyma, but the occlusion in a cavity of the purulent secretion from

the surface of a mucous membrane which lines that cavity. I need not dwell on the anatomical characters of the antrum maxillare further than to notice its peculiar relations to those organs, the teeth, whose affections are by far the commonest cause in the production of the malady we are considering. These relations vary extremely, both as regards the extension of the antrum over the fangs of many or few teeth, and the degree in which those fangs approach or pierce the floor of the sinus. It may extend so as to be in immediate relation to all the teeth of the true maxilla from the canine to the dens sapientiæ, or it may be contracted to such narrow limits as only to correspond with two or three of the central ones. This variation in the size of the antrum is not mentioned in text-books of anatomy, but it is pointed out by Otto.[1] Occasionally a root or roots of the first molar tooth (rarely any other) extend into the cavity, free of any bony covering, and merely overlaid by the mucous membrane lining the sinus; more often, however, the palatine and external roots diverge so as to leave an interval between which the more depending sulcus of the antrum is excavated. Another circumstance in the anatomy of the antrum bearing on the purulent accumulation which constitutes abscess of this sinus, is the very variable size of the orifice which opens into the middle meatus of the nose. In some instances the aperture is barely sufficient to admit the blunt point of a probe; in others it would allow the passage of the end of the little finger. It is always much smaller in the living state when the mucous membrane lines and fills up the opening; indeed, it is the pouting of the tumid mucous membrane which closes the orifice in inflammation. The lining membrane of the antrum is liable, like all other mucous membranes, especially the Schneiderian membrane, of which it is a continuation, to inflammation and altered secretion, mucus being impregnated with or replaced by pus, and accumulating in quantity. This may occur in different degrees, both as to amount and rapidity of development; but the circumstance which here gives importance to this altered and more abundant secretion depends entirely upon the fact that it may become occluded within the sinus by means of the swelling and turgescence of the mucous membrane around its orifice. This, from such anatomical arrangement, converts a mere catarrhal inflammation, spending itself by superficial pus-shedding, into a shut expanding sac, in many respects equivalent to a deep-seated abscess, though by no means identical with that condition either in pathological history or absolute anatomy.

The *causes* of abscess of the antrum may be enumerated in very narrow limits. I believe that in adults, in the majority of cases beyond all computation, it is produced by dental caries, or at least by alveolar abscess, in some stage, associated with tooth-disease. It is stated that the affection may be brought on by a blow on the cheek; and an instance has been recorded in which the malady has occurred in a new-born child, and was supposed to result from the pressure on the cheek during a hard labour.

The *symptoms* of antral abscess vary much in degree; but they usually commence by dull aching pain in the cheek, with heat, redness, and fulness of the soft parts externally. In the early stage there may, or may not, be a purulent discharge from the corresponding nostril; this, however, can only occur to any marked extent before the aperture between the middle meatus and the sinus is closed. As the case advances and the matter becomes pent up, the pain assumes a throbbing character and is severe, and constitutional symptoms manifest themselves analogous to those of acute abscess; the patient has rigors and fever. With this the local symptoms change, and an expansion of the whole jaw shows itself; the malar bone becomes elevated, the fossa beneath it full and prominent; the molar teeth on the affected side appear to elongate, and, in closure of the mouth, meet their opponents too soon; the concavity of the hard palate becomes flat or even convex; the nostril of that side is more or less closed, and, in severe and protracted cases, the floor of the orbit becomes so pushed up as to protrude the eye. Hunter, in describing the symptoms of antral abscess, speaks of the eye being sometimes 'affected;' but in what manner

[1] *Lehrbuch der pathologischen Anatomie des Menschens und der Thiere*, von Dr. A. W. Otto, p. 180. Berlin, 1830.

he does not specify. Beyond instances in which protrusion of the globe [1] has occurred few have been recorded. The inflammation accompanying abscess of the antrum is, however, occasionally so severe as to implicate the periosteum, not only to the destruction of some parts of the maxilla, but extending beyond to contiguous fibrous structures, so as to involve the optic and other nerves in their passage from the cranial cavity to the orbit, producing blindness and fixedness of pupil on the affected side. Such cases are very rare; but one has occurred in my own practice at Guy's Hospital; [2] a second was under the care of Mr. Pollock; and a third is mentioned by Dr. Brück in Casper's 'Wochenschrift.' [3] Necrosis of part of the jaw is one of the rarer accompaniments of this malady; but when any portion of the bone is affected, it is usually either the alveolar processes or the nasal plate of the maxilla.

The manual examination of the jaw seldom fails to indicate the fluid nature of the distending material; fluctuation can be felt, and the thinned bony parietes of the abscess convey to the touch a peculiar sensation, like the handling of dry parchment: as Jourdain very characteristically expresses it, 'quand on appuyoit sur l'os, il s'affaissoit et revenoit ensuite sur lui-même en produisant une espèce de craquement.' [4] If any doubt does arise as to the nature of the contents of an expanding antrum, I am in the habit of exploring the cavity with a minute trocar and cannula not above half the size of a wheaten straw; by this means sufficient fluid, if present, may be made to escape to ascertain its nature, and it could scarcely do injury to a solid growth if such were the character of the expansion. A grooved needle would answer the same purpose, but hardly so readily. The fluid may be too dense to pass these narrow canals; generally, however, it is not thicker than ordinary pus, and it is sometimes serous.

The ultimate issue of these cases varies very much. Occasionally the abscess bursts into the nose: sometimes through the cheek; occasionally into an alveolar cavity, burrowing along the fang, and discharging its pus at the neck of the tooth. More rarely the floor of the orbit gives way, and the pus finds its exit somewhere along the lower lid. Occasionally the orifice which communicates between the antrum and the nose yields temporarily, and there is an accommodating escape of pus: as the patient lies on the other cheek, pus will stream from the nostril of the affected side and then stop, and again make its escape by the same exit.

The *treatment* of this malady is so admirably sketched out by Hunter that I cannot do better than quote his own words:

'The first part of the cure, as well as that of all other abscesses, is to make an opening, but not in the part where it threatens to point; for that would generally be through the skin of the cheek.

'If the disease is known early, before it has caused the destruction of the fore part of the bone, there are two ways of opening the abscess: one by perforating the partition between the antrum and the nose, which may be done; and the other by drawing the first or second grinder of that side, and perforating the partition between the roots of the alveolar process and the antrum, so that the matter may be discharged for the future that way.

'But if the fore part of the bone has been destroyed, an opening may be made on the inside of the lip, where the abscess most probably will be felt; but this will be more apt than the other perforation to heal, and thereby may occasion a new accumulation; which is to be avoided, if possible, by putting in practice all the common methods of preventing openings from healing or closing up; but this practice will rather prove

[1] An extreme case is mentioned by Frank, *De Curandis Hominum Morbis*, &c., auctore Joanne Petro Frank, lib. vi. pars 2, p. 22. Viennæ, 1820.

[2] 'Case of Amaurosis from Abscess of the Antrum caused by a carious Tooth,' by S. J. Salter, *Med.-Chir. Trans.* vol. xlv.

[3] *Wiederholte Entzündungen des Antrum Highmori und Amaurose, etc.*, mitgetheilt vom Dr. T. H. Brück, in Casper's *Wochenschrift*, März 1851, Berlin. A case of a similar character was described by Professor Galenzowski, in *Archives générales de Médecine*, tome xxiii. p. 261. Paris, 1830.

[4] *Traité des Maladies, etc., de la Bouche*, par M. Jourdain, tome i. p. 120. Paris, 1778.

troublesome; therefore the drawing of the tooth is to be preferred, because it is not so liable to this objection.'[1]

Before the abscess has formed, and when, as yet, it is only imminent, it may be arrested by removing any carious tooth or teeth in the neighbourhood; and the application of leeches, fomentations, &c., with the administration of purgatives. In those cases where the pus has already accumulated, and there is no outlet, it will be necessary to make a free opening for the evacuation of the matter; and the method, which universal experience has approved, consists in the removal of a tooth, and the perforation of the antrum at its base. This has the double advantage of removing the cause in most cases, and of allowing the discharge of the matter at the most dependent part of its containing sac. The tooth whose fangs are usually most intimately associated with the antrum is the first permanent molar; and its removal, in a case of antral abscess, is especially indicated from this circumstance, and from the frail and perishable nature of the tooth itself, which gives it less often than other teeth a long tenure of usefulness. The relation of the fangs of the molar teeth to the antrum is an important consideration in the treatment of this disease: in the largest proportion of cases caries of the first molar is the cause, and its removal (opening an alveolus for further perforation) is the first step in the treatment; but any other tooth, molar, bicuspid, or even canine, whose disease should be considered its cause, ought in preference to be extracted, as the absorption around the fang of a carious tooth would render the perforation of the antrum easy, while, by such a selection, this preliminary step would remove the exciting cause of the disease. Indeed, as a rule, it is well to extract all carious teeth from the side of the upper jaw affected with antral abscess. The extraction of the abscess-causing tooth is frequently followed by discharge of the contained pus, in consequence of the fang having extended into the antrum, or the floor of the sinus having been absorbed, resulting from the diseased tooth. It is generally necessary to enlarge the orifice into the antrum; and this is best effected by a naked trocar pushed up the socket of the extracted tooth: the trocar should be large, so as to break down a good deal of the floor of the antrum, thus making a free orifice for the discharge of matter. The absorption of bone which occurs around the fangs of carious teeth much facilitates piercing the antrum in this manner. Perforating the antrum occasionally requires considerable force; and it is necessary to apply this force with great care: the forefinger should be extended on the shaft of the trocar as a guard, and the instrument should be pressed forwards with an even rotating motion. If these precautions are not taken, the floor of the antrum will sometimes give way suddenly, the trocar will traverse the cavity of the sinus, and strike hard against the floor of the orbit, which it may even pierce. I once saw this accident occur in the hands of a young operator, fortunately without any serious consequences. Mr. Coleman has devised a trocar with a guard three-fourths of an inch from the point to prevent such an accident by stopping the intrusion of the instrument further.[2] Occasionally antral abscess is associated with necrosis of some portion of the walls of the sinus; and if this should occur near its floor, the removal of the dead bone will supply an available orifice for the discharge of matter and the employment of injections. The presence of necrosed bone gives to the discharge the peculiar characteristic odour which is familiar to every surgeon: the offensive smell which the pus has, when simply long pent up, is a putridity of staleness, and quite distinct from the dead-bone fœtor. It may not be always easy to remove dead bone at once; and, in such a case, an outlet may be made in its neighbourhood, which will allow the discharge of the matter, and assist in the coming away of the sequestrum when it is detached. If a case were to occur in which the teeth had been long removed, and the alveolar processes absorbed, the floor of the antrum would be more difficult to pierce, on account of the thick compact layer of bone which is constituted by the *osteal cicatrix* after the removal of the

[1] *Practical Treatise on the Diseases of the Teeth*, by John Hunter, pp. 45, 46. 4to. London, 1771.

[2] *Manual of Dental Surgery*, by A. Coleman, F.R.C.S., p. 326.

teeth. In such a case it would be more easy to enter the antrum by perforating at the base of the malar process of the maxillary bone over the region formerly occupied by the second or third molar tooth. The mucous membrane should be divided first; and then the bone, when quite exposed, perforated by means of any instrument suitable for the purpose: a large trocar; or, as Sir B. Brodie suggests, a strong pair of scissors, closed and held firmly in the hand, should be *bored* into the part chosen for perforation.

When the antrum has been perforated, the next step is to secure the complete washing out of the cavity by injections, and the free and continued egress of the discharge by the artificial opening. Warm water should be abundantly used at first, so as to remove all the matter, which is sometimes inspissated. This will give great relief, and the swelling and inflammation will usually subside at once. Should the tendency to pus-secretion continue, an injection of sulphate of zinc, or what in an obstinate case I found very efficacious, a solution (gr. ij. to the ounce) of nitrate of silver in distilled water, may be employed. I am in the habit of using a glass syringe with an ivory nozzle; fitted to the extremity of this is a bent silver tube. In using this apparatus, the silver tube is introduced into the opening in the antrum, and kept there while the syringe is filled and used; and withdrawn, refilled, and used again, many times. When the washing out of the antrum is completed, both the syringe and the silver tube are withdrawn; and now, unless some means are taken to prevent it, accidents of two kinds may occur;—first, food may pass through the orifice into the maxillary sinus; and secondly, the aperture, thus artificially made, may close and cicatrise over. To prevent this, the plan usually adopted has been, to plug the orifice with a piece of wood, which effectually prevents both ill consequences. This is, however, a clumsy method: the same and further advantages may be gained by adopting a plan which I have followed in some recent cases. After the perforation through the alveolar cavity has been made, I have taken a model, and a plate has been prepared to pass over the space occupied by the extracted tooth, and fastened to the contiguous teeth by the customary metallic bands. Through this plate a hole has been bored, which corresponds to the orifice into the antrum; and to the applied surface of the plate a very short tube has been soldered, sufficiently long just to enter the antrum, to occupy the perforation, and prevent its closure. This plate has been permanently fixed during the active treatment of the case, and the orifice in the tube has been kept closed by a plug of cork in the intervals between using the injection. By the removal of the cork, the nozzle of the syringe, which fitted the tube, could be applied, and the injection used any number of times, the tube being sufficiently short to allow the complete washing out of the cavity and the escape of the fluid. This plan of treatment has the additional advantage, that when there is no further need of keeping open the artificial orifice, the plate over the gum facilitates its closure. By removing the tube, and closing the hole by a little sheet of metal soldered on, the passage of air and fluid from the mouth to the antrum is suspended, and the healing of the wound is thereby facilitated, as will be hereafter explained. (See section on the 'Application of Obturators,' &c.)

If in operations for antral abscess any foreign body, which may have caused or be associated with it, such as the fang of a tooth, becomes loose in the sinus, it should be remembered that the cavity is occasionally divided, as shown by M. Giraldès,[1] by partial septa of bone projecting from its walls. In such an instance, the adventitious body may be pocketed in a circumscribed region of the sinus,[2] and can only be removed by some curved scooping instrument introduced into the antrum; and this septate condition, too, would materially interfere with the cleansing of the cavity by means of injections.

VII. *Dentigerous cysts.*—Dentigerous cysts are collections of serum, or some modification of serum, occurring in the maxillary bones, associated with and de-

[1] *Des Maladies du Sinus maxillaire*, par M. Giraldès. Paris, 1851.

[2] An interesting example of this casualty is mentioned by Mr. Cattlin, in the *Transactions of the Odontological Society*, vol. ii. p. 38. London, 1861.

pendent upon impacted misplaced teeth.[1] These serous cysts may result from the presence of a supernumerary tooth or teeth; but in every case recorded, and in all except one that have come within my knowledge, the tooth or teeth have been normal in their presence and serial character, though misplaced as regards position: further, in every recorded case, the tooth or teeth thus implicated in disease, have been of the successional or permanent set, though a solitary instance has happened in the practice of a friend of the author's, in which a temporary tooth was the dental element of one of these cysts. These tooth-bearing serous tumours are, therefore, to be looked upon only as the occasional complications of dentition, in which there is an accidental deviation in the anatomical position of some tooth or teeth. The cysts only arise when the tooth or teeth associated with them are embedded in the substance of the jaw-bone; they do not occur after the tooth has pierced the gum. The embedding of a tooth in the bone does not necessarily give rise to these serous collections, for that is by no means an uncommon occurrence, whereas dentigerous cysts are rare. There appear to be three circumstances which may either of them produce impaction of a tooth in the substance of the maxillary bones: the tooth may be originally developed too deep in the body of the jaw and thus, though it grow in a right direction and in a right position as regards the series, it will never reach the alveolar margin; or, while it may be sufficiently superficial, it takes an oblique direction of growth, so that it lies covered more or less in the axis of the bone; or, again, the position of the tooth and its line of growth may be originally normal, but from an arrest of the development of the fang it may fail to reach the alveolar edge, and so remain permanently impacted in the maxilla.[2] This may occur to any tooth, and has been recorded as affecting most of the permanent set; but it is more common with some than with others: it has been more often met with as regards the upper permanent canines than any other teeth. In cases where a successional tooth is impacted in the jaw, its temporary predecessor is usually retained considerably after the natural period of shedding. When a tooth is thus situated, its fang is enclosed in a bony socket lined by periosteum, as in ordinary circumstances, while the crown of the tooth is free in a little bony loculus lined by that which was the so-called 'enamel-pulp.' This structure is clothed with a sort of epithelium, which is apt to assume the function of secreting fluid. After the enamel is completely formed, the soft membrane which rests upon the surface of the crown of the tooth frequently separates from it, the interval being occupied by a sort of serum. This is

[1] The dentigerous cysts, to which I have above referred, are totally distinct in their origin and physiological meaning from those other tooth-bearing tumours which are found, some in the ovaries of females, and others variously distributed in the bodies of either sex. The dentigerous cysts occurring in the jaw are merely the result of misplacement of a tooth, or tooth-germs belonging to the jaw which contains them. The two other forms of dentigerous cyst neither belong to the individual in whom they are found, nor are they adventitious growths of disease, properly so called. They obviously represent a portion (more or less) of another individual, and indicate some curious aberration of the function of reproduction. The ovarian tumours which bear teeth, and many fœtal structures found in the ovary of the human female, I conceive to be the absolute equivalents of the virgin-produced 'zooids' of those invertebrata which perfect the function of *parthenogenesis* in the reproduction of their kind: that the development of these so-called tumours is the physiological equivalent of this function, though the anatomical result is incomplete. (See 'Ovarian Tumour containing Teeth,' &c., by the author, in *Guy's Hospital Reports*, 3rd series, vol. vi.) Those other tooth-bearing tumours which are found in various parts of the body, irrespective of sex, cannot be susceptible of the same explanation, but suggest the entanglement of an imperfect, or more or less perfect, ovum within the primary one. Teeth appear to be the most constant of the structures entering into the formation of these tumours; but they are associated with other tissues, even in more than one instance to the production of an entire fœtus. These developments receive a probable elucidation by those curious monstrosities occasionally noticed in the ova of birds, in which a small imperfect egg is found *within* a larger primary one—not the common monstrosity of *twin* yelks in one egg, but a distinct miniature egg *within* the larger. (See Retzius, in *Oefversigt af Kongl. Vetenskaps-Akademiens Förhandlingar*, Stockholm, 1847; Baron de Morogues, in *Revue de Zoologie*, 2e série, tome v. Paris, 1853.) Such a circumstance occurring in the human ovum may explain the presence of these dentigerous and many-tissued cysts enclosed within the body.

[1] 'On the Impaction of permanent Teeth in the substance of the Maxillary Bones,' by S. J. A. Salter, in *Guy's Hosp. Rep.* vol. v. 3rd series.

generally the result of some irritation or difficulty in tooth-cutting; and where the irritation runs on to acute inflammation, as in some cases of tedious eruption of wisdom-teeth, the secretion may become purulent. In the deep-seated cases of impaction of teeth, the action is, I believe, always slow, and the secretion almost always serous.

The recorded instances of this condition are so few, that it is scarcely possible to generalise upon them: it may, however, be said that they have usually happened in young persons, at least have commenced in adolescence, shortly after, though sometimes before, the maturation of the impacted tooth. In the cases narrated, the upper grinders have been more frequently involved than other teeth, the serous cysts dilating into the maxillary sinus: but incisors, canines, premolars, and molars, have all been associated with this condition.

M. Jourdain [1] describes three cases of dentigerous cysts. The first case he records was that of a girl, seventeen years old, in whom the right upper first and second permanent molars were inverted, and a large serous cyst had expanded around them into the antrum, with great dilatation of the body of the bone, distortion of the side of the face, and closure of the nostril: it had existed 'some months.' In a second example, a man about sixty years of age suffered from a tumour the size of a pigeon's egg in his upper jaw, for many months, closing the nostril of that side; it was caused by the expansion of a cyst around the second premolar, which was impacted deep in the substance of the bone. The third instance occurred in a girl, thirteen years of age, from a monstrous permanent lateral incisor (side not stated) being embedded in the intermaxillary bone, above and behind the root of the central incisor; 'there was a considerable tumour, which occupied anteriorly the whole region of the maxillary hollow.' It had existed for a year.

Dupuytren [2] describes a specimen shown to him by M. Loir, in which a cyst was developed in the left superior maxilla: this cyst involved, and was dependent upon, the presence of the canine tooth in a reversed position.

I was informed of a case of this disease by my late colleague, Mr. Bransby Cooper, in which great swelling occurred in the substance of the superior maxilla of a young man, in whose mouth the first and second permanent molar teeth had never made their appearance. A free opening was cut into the expansion, when the wanting teeth were found inverted in the axis of a serous cyst expanding into the antrum. No account of this case appears in Mr. B. Cooper's 'Lectures on Surgery,' but I took memoranda of its particulars when communicated to him.

Mr. Wormald operated on a boy, about fourteen years of age, some time since, at St. Bartholomew's Hospital, in whom a serous cyst had expanded about the second bicuspid tooth of the lower jaw; the cyst was the size of a large chestnut, and was in the axis of the bone: the fang of the tooth was not fully developed. The interior of the cyst was lined with a thick vascular membrane, and it contained a glairy fluid. Mr. Wormald has favoured me with these particulars.

F. E. Glaswald published a very learned discourse on this malady, at the University of Greifswald, in 1844, containing a complete résumé of the literature of the subject.[3] The text, upon which this essay was elaborated, was a case that had been under the care and treatment of Prof. Baum. In this instance a cyst had dilated each antrum to an enormous extent, and with hideous disfigurement of feature. The patient was a woman, thirty-eight years of age, and the disease was said to have been in progressive existence for thirty years. From a cyst in the right antrum a canine tooth was removed, and from the left a molar. The fluid in the cysts was purulent.

Three instances of this condition have occurred in my own practice. In one a sĕrous cyst expanded the left angle of the lower jaw in a young man twenty-two years of age, resulting from the impaction of the dens sapientiæ. The cyst was very large, and had been twice opened to allow the escape of serum, which had in each

[1] *Traité des Maladies de la Bouche*, par M. Jourdain, tome i. pp. 119–125. Paris, 1778.

[2] *Leçons orales de Clinique chirur.*, Dupuytren, tome iii. p. 8. Paris, 1833.

[3] *De Tumore quodam utriusque Antri Highmori perversa dentium formatione exorto*, auctor Franciscus Edwardus Glaswald; Gryphiæ, 1844.

instance rapidly re-collected. I extracted the second molar, which was loose: this ruptured the cyst, liberated the serum, and freed the impacted tooth; its crown appeared in the alveolus of the second molar, whose posterior fang was greatly absorbed by the progress of the cyst. The case was entirely cured by this means alone; and the dens sapientiæ gradually rose into the mouth in an oblique position. The second example is very interesting in a diagnostic point of view. A girl, eighteen years of age, had an elastic fluid-containing tumour in the substance of the incisive bone, extending up to the base of the nose on the left side. She had been seen by two or three surgeons; but the nature of the malady was not ascertained. She had the normal *number* of teeth in the jaw, though the *character* of one of them was abnormal for her age. When the patient was sent to me for my opinion, I perceived that the left central incisor was a *temporary* tooth; and this circumstance was a key to a correct diagnosis of the case. The left temporary central incisor occupied a position which its permanent successor should have held: the absence of the tooth, under such circumstances, suggested the almost inevitable position which it must occupy above and behind its temporary predecessor, that is in the axis of the serous cyst. The temporary tooth was removed, and the cyst explored, to discover the succeeding tooth. The permanent central incisor was found deep in the bone, in an upright and natural direction; its crown bare within the cyst; but upon its removal it was observed that the fang was aborted, and had only grown to one-fifth its natural length. This circumstance it was which had prevented its extruding its temporary predecessor, and establishing itself in its normal position. The retention of the tooth in its epithelioid sac furnished the anatomical grounds from which, under favouring circumstances of irritation, the serous secretion arose, and the bone-expansion followed. The third case was that of a gentleman about forty years of age. A cyst, the size of a pigeon's egg, had expanded around the second bicuspid on the left side, the tooth being impacted in the jaw. The fluid in the sac was thick, very dark yellow-coloured serum, containing a large quantity of cholesterine plates.

Pathological specimens of uncommon diseases, and those too not killing or shortening life, must necessarily be very rare. This applies to specimens illustrative of the disease we are considering. One is in the possession of Mr. Samuel Cartwright, jun., and is valuable and instructive in many points.[1] The preparation consists of a right superior maxilla—an adult bone: the teeth that remain, and the alveoli from which others have been extracted, show that the normal number of permanent teeth had developed in their natural position. The turbinated bones are gone, and the antrum maxillare is open. In the antrum, starting from its base, but not attached to its lateral walls anywhere, is an exceedingly thin, delicate capsule of bone, about the size of a chestnut, white with a granulated surface. The bony capsule contains nothing but one small *supernumerary* tooth, which is *loose* and *free* in the cavity. There are three important points in this specimen bearing on the anatomy and history of these cases: the tooth is a supernumerary one; it is free and wholly detached in the cavity of the cyst; and further, the expansion is not that of the antral wall itself, with the tooth's crown uncovered within it, but a distension of that which was the bony loculus of the contained tooth, which, by its further dilatation, would have expanded the antral wall, and probably have been confounded with it.

This latter circumstance appears to me to be of much anatomical interest in reference to those serous expansions of the antrum which are associated with inverted teeth. These have hitherto been described as cysts of the antrum itself: but I cannot conceive that a tooth being 'cut' through the mucous membrane of the antrum should produce such a result. The appearance of the crown of an inverted tooth in the nostril neither causes irritation nor increased secretion—at least no such consequence followed the three examples I have seen; and it seems to me to be far more probable that these cases have commenced as cysts within the bone at the base of the maxillary sinus, expanding into it, and ultimately filling its whole cavity and dilating its walls.

[1] Through the kindness of my friend Mr. Cartwright, I have been allowed to figure this specimen. See *Guy's Hosp. Rep.* 3rd ser. vol. v. p. 328.

Two specimens in the Museum at St. Bartholomew's Hospital throw some further light on the pathology of this condition. One preparation (numbered I. 119) exhibits a thin bony cyst, the size of a small Tangerine orange, with a thick membranous lining: it contained an inferior permanent canine tooth, *loosely attached* to its walls. It was removed from the lower jaw in the region of the contained tooth. The other preparation (I. 119*a*) is the superior maxilla of a young sheep, in which the central incisor is attached to the side of a large cyst; the *fang* of the tooth being *almost wholly destitute of bony covering*. This denudation of the fang does not appear to exist in the early stages of these cases, but seems to be brought about by great expansion of the cyst, and the progressive absorption of bone which accompanies it.

In one instance only am I aware of a dentigerous cyst being associated with a *temporary* tooth. It occurred in the practice of my late friend Mr. Alexander Edwards of Edinburgh. The patient was a young man, in whose upper jaw, just below the orbit, a tumour had developed: the tumour consisted of exostosis from the maxilla, combined with a bony cyst, containing a tooth, which was pronounced by Prof. Goodsir to be a temporary molar: from a portion of the tooth, which I afterwards saw, it appeared to be the second, the larger of the two.[1]

The *symptoms* of a dentigerous cyst are almost wholly local, consisting of a general expansion of the jaw-bone at some particular spot; accompanied by a corresponding disfigurement of the neighbouring features, and a sense of weight and tension at the affected part. Where the impacted tooth has produced pressure upon a neighbour, the symptoms of pain and local distress have been more considerable, and have given rise to some constitutional irritation.

Upon manipulation the fingers readily perceive that the tumour is a central expansion of bone, and that it contains fluid; the bony walls yield to pressure, and then return to shape with that peculiar kind of crepitation which Jourdain characteristically calls *craquement*, like the doubling of stiff parchment; and the bone is usually sufficiently thin at some part to allow the production of fluctuation under the pressure of alternate fingers.

One of the most usual symptoms, and which is also an important *diagnostic sign*, is the absence from the mouth of some tooth or teeth which should have appeared, and have never been extracted. The presence of a fluid-containing tumour within the substance of a maxillary bone at the region of a tooth which is missing, and known always to have been wanting, would be well-nigh conclusive as to its being a dentigerous cyst, though the presence (or the past-known presence) of every mature tooth would not necessarily prove the reverse; for the dental element in the case may be a temporary or a supernumerary tooth. However, an impacted temporary tooth is a very great rarity, and one producing a serous cyst still more uncommon: the same may be said of a supernumerary tooth. The diagnosis may be further advanced by exploring the cyst either by means of a grooved needle or trocar, when a serous discharge would support the idea of a tooth-cyst; and if the cavity be laid open, a probe will scarcely fail to discover the hard unyielding substance of the crown of the tooth.

The *treatment* of these cases is obvious, and usually quite efficacious. It consists in evacuating the contents of the cyst, extracting the tooth or teeth embedded in it, and where the expansion is large, in removing some of the dilated bone. The operations should be performed as early as possible, so as to prevent the necessity of cutting away much bone, and the prolonged and tedious absorption which would

[1] Other examples of dentigerous cysts may be referred to:—'Tumour of the Upper Jaw depending on Cysts connected with the Presence of Teeth in a Preternatural Situation,' by James Syme, Esq., in *Edin. Med. and Surg. Journal*. vol. v. p. 381. Edinburgh, 1838. 'Tumour formed by the Capsule of an uncut permanent Tooth,' by T. Wormald, Esq., *Lancet*, vol. i. p. 756, 1850. 'Dentigerous Cysts,' in Stanley's *Diseases of the Bones*, pl. xviii. p. 20 of Illustrations; London, 1849. 'Three cases of Dentigerous Cysts,' in Forget's *Des Anomalies dentaires*, &c., Obs. x., xi., xii., pp. 41–47; Paris, 1859. 'Case of Bony Dentigerous Cyst of the Lower Jaw,' by S. W. Fearn, in *Brit. Med. Journal*, No. 191, p. 241. 1864. Heath's *Injuries and Diseases of the Jaws*, p. 158; London, 1868.

follow before the face or jaw assumes its natural form. All cutting should, if possible, be done within the mouth. Generally a portion of the wall of the cyst may be removed readily enough with a scalpel; but where the involved tooth is reversed, the expansion is likely to be away from the alveolar border. In that case bone-nippers, the extraction of contiguous teeth, or even the saw, may be necessary. This has been especially the case where inverted teeth have caused cysts in the antrum. The tooth is likely to be found at the base of the cyst, further, *i.e.* from its thinnest expansion. Some difficulty may be found in getting hold of and removing the embedded tooth; but various long-bladed extracting forceps may be readily devised to suit any case if a difficulty should arise.

In some cases, from a persistence of the serous secretion, it has been found necessary to inject the cyst with astringent and stimulating injections.

The issue of these cases is, I believe, always satisfactory. I am not aware that it ever led to necrosis or other bone-disease. In one instance which I saw, a fibrous tumour grew from the cicatrix of the wound some months after the first operation; this was removed, and did not recur.

VIII. Alveolar and maxillary necrosis from (*a*) *Phosphorus fumes;* (*b*) *Eruptive fevers.*

The relation of the phosphorus poison to the disease in question, and its method of introduction, or rather application, are among the most distinctly proved of any of the circumstances connected with the history of disease. Probably there is nothing in pathological history where clear data, and simple induction from those data, have more lucidly illustrated the questions of cause and effect. To bring about the 'phosphorus disease,' phosphorus in some form must be applied to the periosteum, or, what is equivalent to the periosteum, to some raw vascular surface in immediate connection withthe nutrition of bone; and the application must be prolonged, must be under particular circumstances of temperature, and probably of oxidation. These conditions alone occur in those manufactories where phosphorus is employed in the making of lucifer-matches; and there alone (or scarcely with exception) it is that this disease is manifested. But the circumstances which connect the outward cause with the disease that follows it, is a predisposition in the individual, consisting of some exposure of the periosteum, or what is tantamount to such exposure. The only manner in which this occurs, at least in which phosphorus appears to be effective in causing bone-necrosis, is where caries of a tooth exposes the pulp to the poison-influence, the bone-necrosis being that of the jaw. It is the poisoning of the tooth-pulp that is the essence of the disease; the severe combinations of bone-affection, which give all the importance to the malady, are but contingent and secondary consequences. It is this fact in the essential nature of the disease that links it (as I think) to that other form of maxillary necrosis which occurs in children after attacks of the eruptive fevers; only that, whereas in the phosphorus disease the poison is applied to the tooth from an extraneous source—from without—in the jaw-necrosis of eruptive fevers the poison is generated within, and alights upon the teeth and tooth-pulps, by virtue of their being dermal organs, members of the tegumentary system, upon which system generally the eruptive fever-poisons spend their chief destructive force.

Phosphorus disease.—The necrosis and exfoliation of portions of the jaw-bones, dependent on phosphorus fumes as its cause, is so entirely associated with the manufacture of lucifer-matches, made with common phosphorus, that not only are all the particulars we know of the malady derived from the victims of that occupation, but the disease itself was not known to have an existence until some years after these light-producing agents had taken the place of the old tinder-box, and by the large demand for them had given rise to extensive laboratories for their production.

The earliest published account of the disease which we have is by Lorinser,[1] of

[1] have had no opportunity of consulting Lorinser's original writings: they are referred to by Geist, as—'in den medicinischen Jahrbüchern des k.k. Oesterreichischen Staates, Jahrgang 1845, Märzheft.'

the 'Bezirks-Krankenhaus, Wieden;' and the first case which fell under his notice occurred in 1839, about eleven years after the opening of lucifer-match manufactories in Vienna. In this country, as far as I am aware, the malady was first recorded by Dr. Wilks, in 'Surgical Reports of Guy's Hospital,' from April 1846 to March 1847, where he remarks: 'Of the other diseases of the lower jaw, one occurred in a lucifer-match maker, with suppuration and exfoliation of bone.'[1] It is, however, to the Continental surgeons, and those principally of Germany, that we are indebted for the complete and early account of this malady, from which all subsequent notices have been mainly derived. Besides the original memoir by Lorinser, before referred to, important contributions have been added by Strohl,[2] Heyfelder,[3] Roussel[4] and Gendrin, Sédillot,[5] Ebel,[6] and, above all, by Von Bibra and Geist,[7] whose exhaustive treatise, their joint production, has given the clearest elucidation of this new disease.

The most important article on this subject that has appeared in this country has been written by Dr. Bristowe in the form of a Report to the Privy Council 'On the Relation of Phosphorus and its Manufactures to the Question of Public Health.'[8]

That the *cause* of the maxillary necrosis and exfoliation occurring among the artisans employed in making lucifer-matches is the fumes of the phosphorus need not be discussed; the question has been already settled; and the reader is referred to the writings of the authors above named, especially Von Bibra and Giest, for the consideration of this point. The only question on this head which deserved serious inquiry arose from the fact, that the phosphorus employed was often impure, and contained a notable quantity of arsenic; and this Martius and Dupasquier considered might be the essential course of the malady; but this supposition was not found to hold good under more critical and extended examination.[9] It is only when the cause

[1] *Guy's Hospital Reports*, 2nd series, vol. xii. p. 163. London, 1847. This case occurred in the hospital practice of the late Mr. Aston Key, who, as Dr. Wilks informs the author, was already aware, from his own observation, of the essential nature of the disease and its relation to its peculiar cause.

[2] *Gazette médicale de Strasbourg*, cinquième année, No. 11, 20 novembre, 1845.

[3] *Vierteljahrsschrift von Roser und Wunderlich*, Jahrgang 1845, Heft 3; and *Medicinische Zeitung des Vereins für Heilkunde in Preussen*, Jahrgang 1845, No. 45.

[4] *Recherches sur les Maladies des Ouvriers employés à la fabrication des Allumettes chimiques, etc.* Mémoire présenté à l'Académie des Sciences, le 16 février 1846.

[5] *Comptes-rendus des séances de l'Académie royale des Sciences de Paris*, mars 1846.

[6] *Ueber den Einfluss der Phosphorzündholzfabrication auf die Gesundheit der Arbeiter.* Mitgetheilt von Dr. Ebel. In Casper's *Wochenschrift*, 15 März, 1851.

[7] *Die Krankheiten der Arbeiter in den Phosphorzündholzfabriken, &c.* Erlangen, 1847; also *Die Regeneration des Unterkiefers nach totaler Necrose durch Phosphordämpfe*, von L. Geist, Erlangen, 1852. An admirable digest of this subject has been published, in the shape of a review of Von Bibra and Geist's work, in the *British and Foreign Medico-Chirurgical Review* for April 1848.

[8] 'On the Manufactories in which Phosphorus is Produced or Employed,' in the *Fifth Report of the Medical Officer of the Privy Council*, p. 162. London, 1863. I may mention that my article on this subject in the first edition of this work was in type before the publication of Dr. Bristowe's Report, though from the delay in the issue of the fourth volume it did not appear till a year afterwards. But Dr. Bristowe was furnished with a copy of the article, from which indeed he makes quotations.

[9] The actual agent in producing the phosphorus disease is doubtless oxidised phosphorus, probably in the form of phosphorus or phosphoric acid, dissolved in the saliva. The precise nature of the fumes is not exactly known; they consist principally of phosphorus acid (H_3PO_2), which by mixture with air becomes phosphoric acid (H_3PO_3), and probably minute quantities of phosphorus-vapour (P), phosphuretted hydrogen (H_3P), and hypophosphorous acid (H_3PO_4), are also present. Any vapour of phosphorus and hypophosphorous acid would be speedily converted by the air into phosphorous and phosphoric acids. Phosphuretted hydrogen would be more slowly oxidised into the same products. At any rate, nearly if not quite the whole of the fumes when inhaled by the workpeople would be in a state of some acid of phosphorus capable of being fixed and neutralised by an alkali. Such being the case, it is greatly to be regretted that efficient sanitary measures are not adopted to prevent the disease, which surely might be done. The recommendations of Geist and Roussel amount simply to cleanliness and ventilation, and are not sufficient. I would suggest, that in all lucifer-match manufactories there should be a periodic and rigid scrutiny of the mouths of all the workpeople employed. Those having faulty teeth should be excluded from the rooms (the *dipping* and *drying* rooms) where the obnoxious fumes are being developed. All carious teeth should be extracted or plugged. What is more important—a very simple and

has been long in operation, and under circumstances of great intensity, that the disease is developed; it is confined almost entirely to those who are employed in the process of *dipping* the matches into the fused and reeking phosphorus compound, and those who dry them in the same apartment. Moreover, a long exposure to the influence is necessary for the production of the disease. Lucifer manufactories had existed eleven years in Vienna, when in 1839 Lorinser observed the first case which attracted attention; and the shortest known period in which the malady has developed itself was in an instance which occurred in Paris, and is recorded by Gendrin, in which the patient had been employed in the occupation two years before the first symptoms appeared. Another circumstance of curious import, though not invalidating the generally-received doctrine of local poisoning, is, that the sufferer may have been removed from the baneful influence for a considerable period, and nevertheless be subsequently attacked by the disease.

Strohl gives an instance of a girl who had worked as a *dipper* at a lucifer-match manufactory for five years; she left that employment, and adopted a totally different and healthy occupation, when, after three months, she was, for the first time, attacked with unmistakable symptoms of the phosphorus disease, ending after fifteen months in exfoliation of portions of the superior maxilla.

It is very seldom that others than those employed in making lucifer-matches suffer from this malady; but that this may happen should not be lost sight of.

Pluskal[1] mentions an example of a little girl, seven years of age, who was in the constant habit of playing with matches, standing before a wall and discharging them in the dark for amusement, so that her face was bathed in their fumes; in time she was attacked with necrosis and exfoliation of small portions of the front of the lower jaw, with the ordinary attendant symptoms. Simon narrates a case in which the disease appears to have been brought on by a person chewing pieces of ginger, which he kept in his pocket with some lucifer-matches. And Sir J. Paget describes[2] a case in which the malady was induced by the manufacture of medicines in which phosphorus was employed.

The influence of the phosphorus fumes upon the jaw is undoubtedly local. Lorinser, who has the merit of discovering this disease, held a different opinion; but Roussel, Geist, and indeed subsequent writers generally, have adopted the opinion, which all the evidence upon this point seems clearly to establish.[3] I have not space here to enter upon the argument of the question; I may, however, mention one telling fact; it is, the necessity of dental caries in the individual before the disease can be produced. It has never been known to occur, excepting where the sufferer has had carious teeth; and many persons have worked in the manufactories for a long series of years with perfect impunity, who, upon the supervention of dental caries, have been attacked with the malady. Dental caries, by opening the central chamber of

effectual respirator for the mouth might be worn by the employés; it would be unnecessary over the nostrils. It should be constructed on the ordinary plan of respirators, but its centre consisting of a porous diaphragm, such as sponge or some woven fabric, linen or cotton, which should be daily dipped in a solution of one of the fixed alkalies or their carbonates. This would arrest nearly, if not quite, all the acid fumes of the phosphorus. Or the respirator devised by Mr. Graham for persons exposed to carbonic acid vapour would probably be as efficacious. It consists of the mixture in equal bulk of fresh-slacked lime and sulphate of soda, through a cushion of which it is easy to breathe. The wearing of some such respirator should be compulsory with the dippers and dryers. Again, the acid vapour might be neutralised and rendered innocuous by keeping the atmosphere of the apartment ammoniuretted. I believe, if these precautions were adopted, the disease would seldom, if ever, manifest itself.

There is a curious modification of phosphorus, known as 'amorphous' phosphorus, which does not emit noxious fumes when heated sufficiently for its employment in match-making. This kind, however, is not mixed with chlorate of potass (which furnishes the oxygen) for tipping the matches, but is employed to coat the rubber on the surface of the box against which, by friction, the chlorate of potass match is ignited. These matches deserve universal adoption; for not only are they made without possible injury to the workpeople; but they are quite safe, being incapable of accidental ignition.

[1] *Oesterreichische medicinische Wochenschrift*, No. 30. Wien, 25 Juli, 1846.

[2] *Medical Times and Gazette*, vol. i. p. 41. 1862.

[3] The arguments bearing upon this question, and the conclusive inference to which they lead, are stated with cogent force in an admirable clinical lecture on this subject by Mr. Simon, in the *Lancet* for 1850, p. 41.

the tooth and exposing the pulp, seems to offer a tolerably direct channel for the poison to be communicated to the subjacent periosteum, and this, no doubt, is why tooth-destruction is a necessary pre-existing condition. What the precise nature of the action of phosphorus-oxide thus absorbed may be upon the bone is a matter of speculation; but the particular nature of the poison, entering as it does so largely into the composition of the skeleton, is a suggestive circumstance: perhaps, if accumulated by the periosteum, it may generate on the bone's surface a condition of chemical *superphosphate*, inconsistent with osteal vitality.

The *symptoms* of phosphorus-necrosis do not differ essentially from other forms of necrosis in the same parts: they are, however, not unfrequently accompanied by bronchial and pulmonary irritation from inhalation of the fumes: this has been especially pointed out by Sédillot, Gendrin, and Dupasquier.[1] And one of the patients whom I have seen, affected with this malady, has detailed to me symptoms of *spasmodic asthma* which occasionally supervened when he was employed for many continuous hours '*dipping*' while suffering from a common 'cold' in winter weather. Barring this occasional manifestation of pulmonary irritation, the general health of these workpeople is remarkably good.

The symptoms of the jaw disease usually commence with what is supposed to be toothache, the pain being at first pretty much localised to some one tooth that is carious, and which is probably the channel by which the poison is introduced. The advance of the disease is generally slow at first, and, as it were, undecided—indeed, indefinitely chronic; the pain is inconstant, and not early attended with more serious symptoms; presently, however, it becomes more severe and erratic, extending vaguely about the side of the head and down towards the shoulder, and with this severer pain swelling and extreme tenderness occur; the integument near the affected region becomes red, tense, and distended, while the teeth feel elongated and intensely painful when brought in contact with their fellows of the opposite jaw, and they become very loose. The gums are swollen and livid, and this condition extends to the mucous membrane of the cheek. All these symptoms increase till suppuration is established, and with them, more or less, symptomatic fever is developed in proportion to the severity and extent of the disease: the patient has rigors and pyrexia, and is often thoroughly ill. The point at which the pus finds its discharge varies a good deal: the soft parts first become very boggy, especially the gums, and matter often escapes early around the necks of the loose dead teeth; when pointing externally, its approach is accompanied by intense glistening erysipelas-like redness of the integument. The discharge of the pus is attended with great mitigation of the patient's suffering. The pus itself is often sanious at first, and very fœtid, having the odour characteristic of the presence of necrosed bone. The orifice of discharge frequently leads to long burrowing sinuses, especially where the lower jaw is affected; and through these the dead bone may be detected by a probe. The swelling which attends the disease is often very great, particularly when the lower jaw is necrosed: it is diffuse and widespread, encasing the external and under surface of the bone in a prodigious, dense, plastic exudation. In very severe cases, previous to the discharge of pus, while the inflammatory symptoms are at their extreme height, the whole head, except the summit of the scalp, is involved—the eyes are closed; the nose, and even the forehead, swollen; the cheeks, lips, neck, and throat, are one continuous area of florid intumescence. It is a curious circumstance that in the lower jaw the necrosis is attended with a very large and complete development of ossifying callus, whereas none is formed when the upper jaw is effected. The large plastic exudation which surrounds the base of the lower jaw becomes converted into a mass of supplemental bone, supporting the sequestrum, which is, for the most part, naked and bare within and behind, and connecting sound portions of bone at its extremities when the whole of the maxillary arch is not involved. Geist assumes that the particular region occupied by the osteophytic incrustation about the lower jaw is the result of gravitation—an idea altogether too mechanical: it is rather to be looked upon as a physio-

[1] *Gaz. méd. de Paris*, 1846, No. 49.

logical manifestation, and one element in that marvellous exhibition of the *vis medicatrix naturæ* which this repair of the lower jaw displays: the supplemental bone thus placed forms the best support for the sequestrum, and the least interferes with the functions of the mouth; while the absence of an ossifying callus at the upper and inner region of the maxillary arch offers the readiest escape of the dead bone through the thin mucous membrane which there alone covers it, and this without damaging the integument of the face.

As the bone becomes laid bare by the ulceration of the soft parts, it is observed bathed in ichorous pus, ragged and irregular in its surface, and of a dirty blackish grey colour; this latter condition is said to be invariable, as though characteristic; but it is not so, for although very general, I have seen specimens white and clean, and with the compact external layer of bone intact.

To return to the symptoms of the disease. When the extent of necrosis is very great, the constitutional disturbance is correspondingly severe; and in the early stages of the malady the patient may have intense fever, with delirium and agonising local suffering, the more distressing from the region which the affection occupies—interfering with or altogether suspending the action of the mouth, and, by the secretion of foul and fœtid pus, producing nausea, ructus, vomiting. The looseness and projection of the dead teeth is another source of annoyance and distress; as the sequestra containing them emerge from the surrounding parts, their elongation and angularity much irritate the gums and cheek in contact with them. In the severest cases, general sphacelus of the soft parts about the jaw, with œdema of the face and neck, may supervene, accompanied, or not, by erysipelas; and death may then close a scene of terrible suffering. In other instances with a fatal issue, life is drawn out through many months of tedious illness, varied by different degrees of local irritation; till at length the patient, with vital endurance inadequate to the requirements of the disease, sinks, tabid and exhausted, under continuous hectic, and not infrequently with tubercular complications.

But the pathological changes may be more terrible than those already mentioned.

Dr. Ebel describes a case which occurred in the practice of Dr. Hervieux at the Hospital *Necker*, in which the patient, a lucifer-match maker, first had necrosis of the lower jaw, then of the upper, afterwards of the palate bones and the orbits, and lastly of the os frontis. He died with brain symptoms. Pus was found between the dura mater and the brain.

When the malady progresses to a favourable issue, which it does in the majority of cases, the dead bone gradually loosens and becomes detached; and this is generally anticipated by the falling out of some of the necrosed teeth. In the upper jaw the sequestra are usually more broken up and smaller than in the lower, and they are shed easier, not being held in and detained by ossifying callus, which is always wanting in the upper jaw. In the lower jaw the sequestra are usually more extensive, often including large portions of the body of the bone, not infrequently the ascending rami, and sometimes the coronoid processes, and even the articular condyles. The shedding of these sequestra is often hindered by the large surrounding ossifying callus which always forms when the lower jaw is the subject of this disease.

I may here mention that some stress has been laid upon the circumstance that the lower jaw has been more frequently observed to be affected than the upper. The learned reviewer[1] of Geist and Von Bibra's work has given much detail bearing on this point; he enumerates twenty-five examples in which the lower jaw was affected, to twenty-one in which it was confined to the upper jaw. In five cases which I have seen, the lower jaw was diseased in four, and the upper in one; whereas four, which occurred in the practice of a surgical friend, were confined to the upper jaw. In seventeen instances of which I have obtained particulars or seen specimens, nine were connected with the superior, and eight with the inferior maxilla. Dr. Bristowe in his investigations met with evidence of thirty-nine cases in the lower jaw, twelve in the upper, and five in both.

The results of phosphorus-necrosis, in cases which get well, are very various.

[1] *British and Foreign Med.-Chir. Review*, before cited.

As regards general health, the patient usually recovers with an elastic convalescence after the dead bone has been removed; but the physical condition of his maxillary apparatus is often terribly mutilated. When the front part of the upper jaw is affected, it is an absolute and unrepaired loss, miserably disfiguring the patient, altering the physiognomy most painfully; when it affects more hidden parts of the jaw, the loss is not less complete, though less conspicuous.

If the affection is confined to the inferior maxilla, the removal of the sequestrum leaves a supplemental bony representative, which, for a time, more than makes up for the loss of the dead bone, and for a long subsequent period efficiently performs the office of edentulous mastication, and supplies the wants of personal comeliness.

In some instances the whole of the lower jaw has been lost, excepting the articular condyles; and these apparently connected with the new bone, have established the joint requirements of the supplemental jaw; but in other instances (cases in St. Bartholomew's Hospital, and those mentioned in Geist's later work [1]) even the articular ends have been shed with the rest of the sequestrum: still there has been joint movement, doubtless from a ligamentous attachment of the new bone.

This repair of the lower jaw is, however, generally but temporary; for after a time—often a considerable time—the new bone diminishes, by absorption, to a mere narrow arch, and ultimately there is scarcely enough bone to keep out the lower lip, and the chin is utterly lost. I have had an opportunity of examining this state of parts after the lower jaw had been removed ten years. Dr. Bristowe, however, mentions two instances, one after six, and one after ten years, in which the supplementary bone remained large and well formed; but he describes another in which, after eight years, the new jaw was scarcely bigger than the hyoid bone. How far the loss by absorption of supplemental bone may be prevented by supplying it with a function, through the means of artificial teeth, is a question of theoretical interest and of practical importance.

The *treatment* of phosphorus-necrosis of the maxillæ divides itself into that which is common to all bone-necrosis, and that which specially applies to the particular local affection in question. Upon the latter head alone I would remark.

In the early stages of the disease, when as yet it is not established, but its supervention feared, it would be of the last importance to remove the patient from the cause of the malady; pure air should be sought, abundant cleanliness, with urinary and alvine excretants, resorted to, and all suspicious teeth extracted. When, however, the local symptoms—extreme pain, swelling, and indurated infiltration of the soft parts—develop themselves, and the disease has already passed its premonitory stage, it will be advisable to have recourse to more active measures. Upon this point I cannot do better than quote Mr. Simon's remarks in his admirable clinical lecture, already referred to, and in the justice and propriety of which I entirely concur: 'So soon as the second or inflammatory stage of the disease has thoroughly set in, the bone seems in every case to be irrevocably doomed to necrosis; and I would therefore recommend you, in the event of your being called to a case at the transition period between the two stages, when hypertrophy is passing into inflammation, to adopt without hesitation the most active measures for the relief of the periosteum and bone. Leeches and general antiphlogistic treatment *may* do good; but the consideration of the pathology of this disease, together with the analogy of other periosteal affections, leads me to believe that the only real chance of doing good would lie in still more energetic measures; and I would recommend you in any such instance to make with your scalpel free vertical incisions through the gum wherever tenderness and swelling exist; extending your line of cut upwards in the upper jaw, or downwards in the lower, as far as the structure of the parts will allow, bringing your incisions as near together as circumstances may require, and in every point carrying them clearly down to the bone, so as to afford the utmost relief and relaxation to the overloaded and tense periosteum. I believe that this method of procedure would be the nearest approach to an effective one for checking the inflamma-

[1] *Die Regeneration des Unterkiefers nach totaler Necrose*, v. L. Geist, 1852.

tory stage of the disease before it has reached an intensity which must inevitably destroy the jaw.'

When the stage of threatening has past, the extent of the inflammatory mischief appears to assert itself at once—the whole of that portion of bone which is subsequently the sequestrum appears to be stricken from the first. Prevention is at an end, and palliation rather than cure is indicated as the surgeon's mission. When pus has formed, it should be early conducted to the surface, and by judicious interference external scars may often be prevented by means of well-directed punctures within the mouth. The whole of the teeth implanted in the dead bone become loose, and apparently elongated ; their doom is already sealed, and they should be extracted without delay, as they cause much irritation to the tongue and cheeks.

When the discharge has established itself, and the fœtid pus is pouring from the sinuses that communicate with the dead bone, abundant rinsing of the mouth should be had recourse to, not only in the form of mere washes with water to remove the filthy secretions, but astringent and deodorising lotions, such as decoction of cinchona, and solution of alum, solution of chloride of lime, and, still better, solution of permanganate of potass. As has been pointed out by Mr. Simon, the unhappy patients are sometimes so disabled as to be incapable of gargling out their mouths, and then little pieces of sponge may be used by them to wipe away the stinking discharges.

As regards the sequestra little can be done. Sharp projecting pieces of bone may be cut off by nippers ; but the bulk of the dead bone must take its own time to be shed—often a very long time. It is a period of miserable suffering to the patient, and terrible constitutional exhaustion ; but it cannot be shortened or its results anticipated.

In March 1862 I saw in the London Hospital, under the care of Mr. Adams, a patient who had been suffering from the disease, affecting the entire inferior maxilla ; it had been going on two years and a half ; the latter four-fifths of the time with the lower jaw, except probably the articular ends, dead and lying in the mouth, bare and ghastly, bathed in ichorous pus within its huge supplemental successor.[1]

The sequestra of the superior maxilla are apt to be more detached than those of the inferior—divisible and smaller, and they can be brought away piecemeal ; moreover, as the upper jaw is an attached, and not, like the lower, a floating bone (with muscles ready to displace its parts when the integrity of its arch is broken), its dead portions can be removed without jeopardising the relations of the rest of the bone. Therefore a little and early surgical interference may be employed without injury, and parts brought away which, if belonging to the lower jaw, had better not be interfered with. In the lower jaw the disease is usually so much more comprehensive, and its resultant sequestrum is so solid, that patient watching and palliative treatment are all that can be adopted generally till the very close of the case. Earlier interference might disturb the relations of the supplemental bone (the *natural splint*) and the portions of jaw still living, and by allowing the strong antagonistic action of the muscles attached to the two halves of the latter to act separately, lead to the permanent displacement of the elements of the maxillary arch. The articular ends of the bone often—indeed, in the majority of cases, though not always—escape the necrosis, when the whole of the rest of the bone may be destroyed ; and this circumstance suggests an element of treatment which may much shorten the patient's suffering. When the necrosis has evidently passed up to the neck of the condyles, the bone may be removed by sawing or nipping across the neck as high up as possible

[1] The necrosed jaw was afterwards removed. The operation and its sequence were both unusual. The patient was placed in a kneeling posture, with the chin on a table, and, the mouth being open, the symphysis of the jaw was split down by a chisel and mallet. The right half of the bone was then seized by large strong forceps, and wrenched from the mouth with great force. After a week the same course was adopted with the left half ; but this required still greater traction. The entire bone was thus brought away, including the condyles. Ten days after the first operation the patient was seized with secondary hæmorrhage, profuse and arterial, on the *right* side from the wound, where the first portion of jaw was removed. This necessitated ligature of the right common carotid artery. The latter operation was performed by Mr. Maunder, and the patient recovered perfectly. See *Med. Times and Gazette*, July 5, 1862.

(on either side, if both sides are affected), and then dividing the bone of the jaw at its symphysis; the two halves of the bone may be withdrawn, one by one, without any external wound. Should the condyles be necrosed and follow, no harm will have been done by the previous operation, and the patient's suffering will have been much diminished and curtailed. The division of the bone may be accomplished by a Hey's saw, or some modification of it improvised to suit the particular position of the required line of section. Variously curved bone-nippers may also be devised to accomplish the same objects. The extreme and firm closure of the mouth sometimes renders this operation very difficult.

I need not dwell upon the general treatment of these cases as far as they are in common with those of bone-necrosis generally. The particular region affected, however, involving and disabling, as it does, the masticatory function, entails some modifications. In the long tedium of their course every effort should be made to supply, by suitable food, the deficiencies which suspended mastication entails—mashed meat, eggs, cod-liver oil, and such sustainants, should be abundantly employed; and iron salts, in moderate proportion, should, if bearable by the patient, be almost a matter of daily diet rather than an occasional medicine.

There is one point which I would allude to—more a matter of pathological curiosity than having any other bearing; it is the enormous amount of pus which these patients daily swallow and (apparently) digest; it must be many ounces, and this without any obvious detriment to health; the patient's condition being no worse than may be accounted for by the force of the local symptoms.

Exanthematous jaw-necrosis.—I believe that the necrosis and exfoliation of the alveolar processes and portions of the jaws in children, consequent upon the eruptive fevers, is essentially the same as the maxillary necrosis in the victims of phosphorus fumes, and that it is the result of the local application of a specific poison to the vascular parts of teeth. There is this difference, however, that in the cases we are now considering the poison is generated within the individual, but with affinities for certain structures and tendencies to action upon certain organs which give its morbid consequences an equally local character. Whatever opinions may be entertained as to the homological relations of the several tissues of the teeth to those of the general integument, there can be no question as to their being members of the dermal system, and as such we should *à priori* expect that they would share the consequences which attend those particular diseases which spend their chief force on the skin. There is one circumstance, however, that modifies such an anticipation; it is the low state of vitality of the teeth, and the extremely slight nutritional changes which occur in them *when once they are formed,* and which must consequently remove them to a great extent from those transient though potent influences which would destroy or morbidly affect vascular or rapid-growing tissues. But such a qualification does not apply to the conditions of the teeth during their development. From the time of birth till the eighth or ninth year, the jaw-bones are the seat of intense developmental nutrition in the formation of the teeth, and are among the most vascular parts of the body; about the middle of the period named, five years of age, the maxillæ contain no less than forty-eight developed teeth and developing tooth-germs. It is about this time that the poison of the exanthematous fevers appears to exert its most deadly influence on the dental system.

The form of necrosis affecting the alveolar edges of the maxillæ, and accompanied by the shedding of the teeth, which we are now considering, was, I believe, first recognised by myself[1] as one of the sequelæ of the exanthemata, and dependent necessarily on their previous occurrence. Many isolated cases of the affection have been described, and our museums contain specimens of the sequestra; but the supposed relation of cause and effect had not, so far as I know, been expressed before.[2]

[1] 'On the Shedding of the Teeth, and Exfoliation of the Alveolar Processes, consequent upon the Eruptive Fevers,' by S. J. A. Salter, *Guy's Hospital Reports,* 3rd series, vol. iv. Several specimens of sequestra from these cases have been figured by the author in the *Transactions of the Pathological Society,* vol. xi. pp. 209–215.

[2] The earliest recorded cases are mentioned by Fox in his *History and Treatment of the*

This affection is by no means common, considering the almost universal occurrence of the eruptive fevers. The very large population tributary to Guy's Hospital has only furnished me with twenty-three or twenty-four cases during the last nine years; and I have reason to think that even in this I have been disproportionately favoured.

The cases are all singularly alike. A little child has just recovered from one of the eruptive fevers, most probably scarlatina; the case has been in no way unusual as to its severity or its course; within six weeks or two months of the passing off of the acute symptoms, tenderness of the mouth is complained of, and the mother notices fœtor of the breath. Upon inspecting the mouth, the gum is seen to be peeling from the edge of the jaw around the neck or necks of some temporary tooth or teeth; pus is discharging, and more or less dead bone is exposed. The denudation of the bone progresses rather quickly in depth, but usually not after the first in lateral extent; the temporary teeth at the affected part become loose, and often fall out. There is no swelling; and no ossifying callus is formed in the region of the necrosed bone. In a few weeks from the first of these symptoms, the sequestrum itself becomes loose, and is easily removed, leaving a large gap, and a raw granulating surface, which rapidly heals. The necrosis almost always includes the bone which constitutes the loculi containing the developing permanent teeth, as well as the alveoli of the temporary; but it does not go further, and in the lower jaw the base of the bone is very rarely affected. I have never seen such an occurrence. The disease is frequently symmetrical: when attacking the bone about the temporary molars on one side of the jaw (its most common situation) it often manifests itself immediately after on the opposite side, and sometimes in the same regions of the other jaw. The same symmetry is observed in the front of the mouth.

As far as I am aware, this affection only occurs after the eruptive fevers,[1] and scarlatina is its most potent cause. In the instances which have been under my own care, two were after small-pox, five or six after measles, and fifteen or sixteen after scarlet fever. There is, however, nothing in the condition of the mouth to indicate which has been the precursor. The age at which this affection occurs is usually about five years: from three to eight are the extreme limits I have known.

The issue of these cases is simply comprised in the loss of a certain amount of bone with the contained teeth, and the consequent disfigurement. As the permanent teeth are lost with the temporary, the disfigurement is very great when it affects the incisors; but when the temporary molars and their successors, the bicuspids, suffer, the damage is comparatively slight. I have seen two examples of adults where this has happened in childhood, and the alteration of the face has been wonderfully little: the first molar approaches very close to the canine, and the second and third molars come well forward into the mouth, filling out the cheeks, and exhibiting no external evidence of what has occurred. In one solitary instance which I saw, in which the permanent tooth was not shed at the time when the bone and temporary tooth were lost, it was in effect equally destroyed, for the tooth was blighted—it did not grow after that time; no fang was formed, and when cut it remained a mere toothcrown, loosely attached to the surface of the gum.

The *treatment* of these cases involves little beyond patience and cleanliness. No operative interference is indicated; the extent of the necrosis asserts itself from the first, and cannot be curtailed. Soon the sequestrum becomes loose, and may then be

Diseases of the Teeth, p. 112. London, 1806. These cases, two in number, occurred after small-pox.

[1] I have heard of one doubtful case after continued fever (typhus or typhoid); but this would form no real exception to these cases or their pathological interpretation. The continued fevers have their specific cutaneous eruptions; and their damaging influence on the tegumentary system is sufficiently attested by the falling of the hair in convalescents from them. I would not, however, be supposed to deny that jaw-necrosis, associated or not with death and exfoliation of other bones, may occur in children as the result only of extreme cachexia or depressed vital nutrition. I merely wish to assert my belief that the particular form of alveolar necrosis above described is one of the *specific sequelæ* of the eruptive fevers, and is related to its cause in the manner indicated in the previous pages.

readily removed by dressing-forceps. I would suggest a weak solution of *permanganate of potass*, as a cleansing and deodorising mouth-wash. Any general symptoms of disturbed health should be met on ordinary principles. Where the suppuration is profuse, and the bone-necrosis extensive, stimulants and tonics may be required; and in the scarlet-fever cases steel would be a useful adjunct; but I would observe, that in the cases I have seen, the children were, for convalescents, in remarkably good health, and had, almost without exception, escaped the other ill consequences of the eruptive fevers.

IX. *Hæmorrhage after extraction of teeth.*—Long-continued and obstinate bleeding after the extraction of teeth is an occasional and troublesome complication of this operation. It is not a common consequence: indeed it is very rare, considering the enormous numbers of the operations, and how seldom in proportion continued bleeding follows them. The troublesome hæmorrhage from the wound of an extracted tooth is of a peculiar character: it is not a rapid arterial discharge immediately following the vascular rupture which the tooth-extraction causes, but a continuous, abundant flow of blood welling up in the empty socket, and developing itself into a serious and sometimes alarming symptom, usually many hours after the operation. The profuse pouring-out of vivid arterial blood which sometimes follows the drawing of a tooth has no relation to the circumstance we are considering; that generally lasts but for a few minutes, and then ceases. The continued hæmorrhage is not the discharge of any considerable arterial trunk that may have been wounded, as has been supposed, but the passive bleeding, as it seems, of the entire disrupted surface, from an inability of the vessels to accomplish the curative closure of their broken ends. In the majority of the recorded cases there has been distinct evidence of the existence of the hæmorrhagic diathesis in the individual affected; and in not a few the patients have themselves been aware of the tendency, from having experienced similar consequences attendant on the previous extraction of other teeth. Indeed, some persons (I have some such patients of my own) refuse to have any more teeth removed, preferring rather to suffer any amount of toothache, on account of the alarming hæmorrhages which have followed the operations before.

In one case which came under my treatment, there was no history of a hæmorrhagic tendency; but the patient was a young lady, and the circumstance occurred just as menstruation was imminent. The bleeding was very considerable, and continued for two days, when under the influence of emmenagogues (hot hip-baths and aloetic purgatives), the catamenia appeared, and the hæmorrhage from the alveolus immediately ceased. In this case, doubtless, the bleeding was a vicarious manifestation of the periodic function. A very interesting example of this distressing consequence of tooth-drawing, showing its constitutional nature, was under my care some years since. A clergyman from one of the midland counties came to town to me on account of the hæmorrhage which had followed the extraction of a lower molar tooth three or four days before and was still continuing. He was reduced to a pitiable condition of exhaustion and bloodlessness. All the local means usually adopted had been tried, but without success: the bleeding, however, speedily ceased under the use of large and frequently-repeated doses of *tannin*. The history of this gentleman and his family is curious and instructive. As a boy, from the most trivial accidents, such as a cut finger, he sustained prolonged and almost irrepressible bleeding: during his whole life, the slightest blow or bruise would cause a large and very disproportioned ecchymosis; a few years before, he had sustained a week of hæmorrhage after the extraction of a tooth. This gentleman has three married sisters, all of whom suffer from terrible floodings at the birth of each child. He has a little boy, as liable to bleeding from a trivial wound as he was in his childhood.

It is of special importance to bear in mind the general and diathetic nature of alveolar hæmorrhage, in devising its proper treatment. Anything which would increase the wound, or add a fresh one (such as the cautery or the ligature of an arterial trunk), is contra-indicated.

A fatal example of alveolar hæmorrhage, in which both these means were adopted, is recorded in an early number of the 'Transactions of the Royal Medical and Chirurgical Society of London.'[1] The previous history of this patient is singularly like that of the clergyman whose

[1] 'A Case of Fatal Hæmorrhage from Extraction of a Tooth,' by Richard Blagden, *Med.-Chir. Trans.* vol. viii. 1820.

case I have just mentioned, in the hæmorrhagic diathesis manifesting itself in childhood, and his having sustained a terrible loss of blood—the bleeding lasting for twenty-one days—when another tooth was extracted before. In the treatment of this fatal hæmorrhage, the actual cautery produced only a temporary arrest of bleeding; it was then determined to tie the carotid artery; the operation was performed by Sir B. Brodie, without any relief to the original symptoms; the wound in the neck only furnished another bleeding surface, and evidently hurried on the fatal catastrophe. In another recorded case where the cautery was used, the edge of the lip was accidentally burnt, and the surface thus cauterised soon commenced bleeding profusely, and continued to do so till the fatal termination of the case, which was hastened by it.

The *treatment* of this form of hæmorrhage divides itself into local and general; the local treatment consisting in the application of styptics, with continuous pressure upon the bleeding surface; the general treatment, in the rapid and abundant administration of internal astringents. The local plan of a plugging compress, recommended by Hunter, is that now universally adopted: 'In general it will be sufficient to stuff the socket with lint, or lint dipped in oil of turpentine, and to apply a compress of lint, or a piece of cork thicker than the bodies of the adjacent teeth, so that the teeth in the opposite jaw may keep up a pressure. It has been advised to stuff into the socket some soft wax, on a supposition that it would mould itself to the cavity, and so stop the bleeding: this, perhaps, may sometimes answer better than the other method, and therefore should be tried when that fails.'[1] The restoration of the extracted tooth to the socket has also been tried with success. For the purpose of forming a plug of lint, a strip should be cut of an elongated wedge-shape, and this should be introduced, the pointed end first; the extremity should be introduced into the bleeding socket, and driven well home to the bottom; the strip of lint should then be folded and re-folded upon itself, so as to make the plug very solid and pressing on the entire superficies of the socket. When the compress of lint or cork has been applied, the mouth should be closed and the jaws kept permanently together, so as to exert considerable and persistent pressure by means of a broad bandage tied under the chin and over the head. Where the opposing teeth in the other jaw are wanting, it may be difficult to keep up the compress-pressure by the mere closure of an edentulous jaw upon the bleeding alveolus. Mr. Higginbottom of Nottingham was, I believe, the first to invent what he called an *alveolar tourniquet*.[2] It is an instrument consisting of two blades, or shafts, united at one end, and capable of approximation and compression by means of a screw, and free at the other extremities; these latter are armed with pads, one applying to the compress in the mouth, and the other to the exterior: where the bleeding is in the lower jaw, the blades are nearly equal, the exterior one simply passing under the base of the horizontal ramus: for the upper jaw the instrument is less applicable, and the outer blade requires a long curved sweep, so as to grasp the top of the head. Various local astringents have been recommended in conjunction with the lint-plug: matico has been highly spoken of: I have found an alcoholic saturated solution of tannin answer the purpose very well; but probably the old remedy, turpentine, has never really been superseded.

I am convinced, however, that it is a great mistake only to treat these cases topically: they are most obviously manifestations of constitutional vice, and require a corresponding general treatment. Astringents should be had recourse to at the earliest stage; they can do no harm, and may be suspended at any time, while in the majority of cases they will be most beneficial. These cases often extend over so long a period that constitutional treatment has abundant time to be brought into full operation. Tannin and turpentine have been the most successful of internal remedies in recorded cases; with the latter drug, steel might be advantageously combined, especially in the form of the muriate tincture. In the irritability of sanguineous exhaustion, opiates may become necessary in large doses.

[1] *A Practical Treatise on the Diseases of the Teeth*, by John Hunter, p. 92. London, 1778.

[2] 'On Arrest of Bleeding after Extraction of Teeth,' by J. Higginbottom, F.R.S., *Prov. Journ.* vol. iv. 1842.

Other circumstances require attention: the patient should occupy a cool apartment, and local icy applications may be beneficial. Unless contra-indicated by faintness or excessive loss of blood, the upright posture is to be preferred: or if the patient goes to bed, he should be bolstered up in as elevated a position as possible, while the circulation in the lower extremities should be encouraged.

In women during the menstruating period of life, it should not be forgotten that the hæmorrhage may be associated with suppressed menstruation, and constitute a vicarious discharge; and remedies should be adopted to meet this contingency.[1]

X. *The application of obturators and false palates in cleft palate, &c.*—The title of this section is scarcely in keeping with the heading of my essay—'Surgical Diseases connected with the Teeth,' &c. The maladies which give rise to perforations and clefts of the palate are, practically speaking, very seldom dependent on diseases of the teeth; but the particular region of their resultant defects, and the nature of the mechanical dentist's art, as remedying those defects, bring this matter fairly within my province.

The two forms of cleft or perforate palate, congenital and induced, are very unequally suited to this particular plan of treatment; a large number of the former may be radically cured by means of surgical operation, which is always preferable where practicable; in the latter cases, the mechanical assistance of obturators is of more avail, and, in many instances, not only removes an existing defect for the time being, but is to a great extent curative.

In congenital cases, when *very* severe, this is the only method applicable for the treatment of the great physical defect, no operation being capable of bringing into apposition the separate masses on either side of the cleft, or of remedying the defect of soft parts, which consequently require to be supplied by new and foreign material.

When the cleft or perforation consists of an aperture in the hard palate only, as in most syphilitic and scrofulous cases, and some congenital, an arch of metal or other hard substance spanning over the orifice, and firmly applied to the contiguous palatal surface, is all that is required. When, however, it extends backwards and involves a destruction of the velum palati, and that to an amount which cannot be remedied by surgical operation, it becomes necessary to add to the metallic arch an elastic flap (such as vellum or india-rubber), which will supply the mobile functions of the soft parts as they are when in a normal condition. The former apparatus may be styled *obturators*, the latter *false palates*. In not a few of these cases other portions of the upper jaw become implicated; the alveolar processes may be necrosed, involving the loss of the contained teeth and sometimes considerable masses of bone. To replace these losses various combinations of obturators, false palates, and artificial teeth have to be constructed, and they may be made in every variety, the different parts being associated together to supply lost parts and to fit by close adjustment those that remain.

The materials of which obturators are made may vary; carved ivory, vulcanite (indurated sulphuret of caoutchouc), or flattened metal—gold, platinum, dental alloy, or silver—are all employed. The first, however, is now generally discarded, from its perishable nature. Vulcanite has been extensively adopted; but its thickness, and fragile character when very thin, militate against it in many cases. I much prefer sheet metal, on account of its strength, thinness, and durability. Silver, platinum, or dental alloy may be employed for hospital purposes; but gold is far better, and I am in the habit of using it, except in hospital cases. It is an object to have the sheet of metal as thin as possible without weakening it; and I employ the gold plate reduced to No. 6 of the gold-flatter's gauge, being somewhat thinner than is usual for the frames on which artificial teeth are mounted. This degree of tenuity is quite compatible with entire firmness, and it receives better all the inequalities of the rugous palate: when a plate of this thickness is perfectly adapted to the palatal arch, it is scarcely appreciable to the wearer. As long as sound teeth remain in the

[1] On the Hæmorrhagic Diathesis, see vol. i. pp. 718 *et seq.*

upper jaw to which the plate may be attached, it should be supported by means of clasps or collars embracing them; when these are lost, the same object may be achieved by connecting the obturators by means of springs with a frame resting on the lower jaw. Under no circumstances whatever ought support to be obtained either by dilating sponge, or by hooks, or other processes passing into the nasal cavity —the effect of which is to increase the size of the orifice, or prevent its natural tendency to contract. The [1] old and still very common method of treatment, consisting of a disc of metal with a piece of sponge attached to its upper surface passing into the nose, cannot be sufficiently reprehended; it is filthy in its nature, and most injurious to the unfortunate patient's future condition, as the pressure of the expanding sponge causes progressive absorption of the margin of the orifice to an unlimited extent. Any plug kept in position by tight-fitting acts in the same manner. There is a preparation in the Museum of St. Bartholomew's Hospital (ser. I. no. 232) of the skull of a person who lost a portion of the palate, probably by syphilis, and who obtained temporary relief by stuffing the oro-nasal aperture with a large cork, gradually adding to the size of the plug to meet the requirements of the ever-increasing orifice, till the whole of the hard palate had disappeared, the palatal processes of the ossa palati as well as those of the maxillæ being lost. The progressive absorption under this continually-advancing pressure had removed the vomer, the inferior turbinated bones, and the nasal wall of the maxillary sinuses. Such a specimen is an eloquent commentary on this reprehensible plan of treatment. I believe in no instance is it necessary to gain support by the passage of processes of any kind into the nasal cavity, either to wedge against the sides of the orifice, or to rest upon the nasal surface of the palate.

But an obturator passing over the perforation is not negative in its effect. An orifice which, allowed to remain open, may continue *in statu quo*, or contract in a degree scarcely appreciable, will often rapidly diminish in size when the passage of air and fluid between the oral and nasal cavities is prevented. This is not generally known or understood; but it is of great importance in treating these cases. The obturator should be applied as early as possible—as soon as the dead bone has come away, and while the wound is in a state of granulating activity. It is surprising how the granulations will stretch across the upper surface of the obturator, and close up the orifice; and, in more advanced and neglected cases, the same condition may be

[1] Among the earliest surgical writings we find notices of mechanical appliances to repair lesions of the palate. The still common obturator, consisting of a metal disc supported by a sponge passing through the perforation into the nose, was invented by Ambrose Paré, an eminent French surgeon (*Les Œuvres d'Ambroise Paré*; à Lyon, 1541). These and analogous apparatus on the same objectionable plan, were alone employed until Bourdet devised others on correct principles (*Recherches et Observations sur toutes les parties de l'Art du Dentiste*, par M. Bourdet; Paris, 1767). Bourdet employed thin sheet metal in the form of a vault wholly within the mouth, attached to the teeth at the sides, and free from any projection into the nose; and he was aware that when thus treated the orifice would contract and frequently close. M. Pierre Fauchard appears to have been the first person who combined artificial teeth with an obturator (*Le Chirurgien-Dentiste*; Paris, 1786). M. Touchard published an account of an apparatus not only to supply teeth and palate, but also a large mass of upper jaw which had exfoliated. This was effected with ivory (*Description d'un obturateur dentier présenté à la Société de Médecine de Paris*; Paris, 1814). M. Delabarre was the first person who succeeded in supplying a soft as well as a hard palate. He accomplished the former with sheet caoutchouc, as have nearly all his successors (*Traité de la partie mécanique de l'art du chirurgien-dentiste*, par C. F. Delabarre; Paris, 1820). But the greatest advance in the construction of false palates was made by Mr. Snell, whose apparatus was essentially the same as those employed in the present day (*Observations on the History, Use, and Construction of Obturators, or Artificial Palates*, by James Snell; London, 1824). The same principles have been carried out, with slight modifications, by Mr. Stearns (*Lancet*, vol. ii. 1845. pp. 7, 260, 284, 310); and by Mr. Sercombe ('Cleft Palate; its Surgical and Mechanical Treatment,' *Trans. Odont. Soc.* vol. i. London, 1858). Dr. Kingsley, of New York, has devised an ingenious arrangement which very firmly and effectually closes the cleft of the palate. It consists of a wedge-shaped plate of hard vulcanite with a soft velum, forced forward into the fissure, and resting by a ledge upon the nasal surface of the hard palate, thus reverting to the objectionable principle adopted previous to the time of Bourdet ('On the Treatment of Congenital Cleft Palate,' by Dr. N. W. Kingsley, in *Trans. Odont. Soc.* vol. v. p. 195; London, 1865).

imitated to some extent by frequently scarifying the edges of the perforation, always taking care immediately to restore and keep in place a well-fitting obturator. Why the removal of the ill *effects* of a perforate palate (passage of air and fluid from nose to mouth, and damaged voice), by means of mechanical appliance, should lessen or remove its *cause*, is not very apparent: it seems a curious transposition of events—an inverted sequence: perhaps the protection afforded by the plate to the granulating edge may to some extent account for it: it is, however, true, and very important practically.

Occasionally a portion of the floor of the antrum is lost by necrosis in cases of severe 'abscess' of that sinus, and its cavity becomes common with that of the mouth, by an aperture of variable size. This orifice should be immediately closed, or rather spanned over, by a plate (upon which substitutes for the lost teeth may, or may not, be fixed), and the result will be, in many instances, the development of a membranous growth supplying the lost bone, completely scarring over the wound, and forming a floor to the sinus. Mr. Coleman records an instance in which an orifice into the antrum, through loss of bone, scarred over and closed under the influence of the thermal cautery repeatedly applied.[1]

The exact nature and arrangement of the artificial appliances we are considering will perhaps be best elucidated by illustrative cases.

The accompanying figure (fig. 117) represents the upper jaw of a girl who has recently lost a portion of the hard palate from the effects of inherited syphilis. This cause is, I believe, unusual. I have not seen or heard of another case in which

Fig. 117.

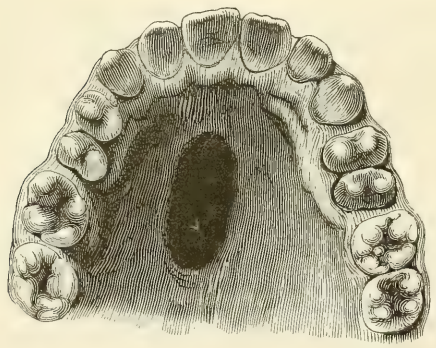
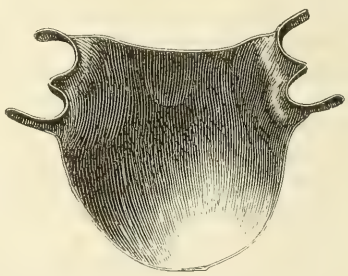


Fig. 118.



congenital syphilis has had such a result. The patient has suffered from characteristic keratitis, as well as from other symptoms of the disease. The loss of the bone was attended with all the customary conditions of suppuration and fœtor, and after it came away a hole into the nose was left, as depicted in the woodcut. The patient's power of speech was seriously affected, and food and drink passed into the nose. A few days after the bone came away, I took a model of the mouth, and an obturator plate was made as represented in fig. 118. The girl being an hospital patient, the metal employed was 'dental alloy,' an alloy of silver and platinum, being less costly than gold. Support for the plate was obtained by collars passing between the bicuspids and first molars and the bicuspids and canines.

The application and fixing of the obturator *immediately* restored all the functions of the mouth: food was occluded from the nose, and articulation and enunciation were perfect.

This immediate restoration of the voice nearly always, I believe, occurs when *accidental* perforations of the palate are thus treated, and very soon, even where the soft palate is involved in a cleft and an artificial velum has to be supplied. But with congenital cases it is very different; and the patient has in them to commence a new oral education.

I saw this case again about three months after the introduction of the obturator:

[1] *Lancet*, Oct. 1, 1881, p. 613.

the hole had contracted to less than half its original size, and will probably close altogether.

The apparatus needed to supply the defects of cleft palate is more complicated, but is scarcely less satisfactory in its ultimate results. The accompanying figure (fig. 119) represents the upper jaw of a young gentleman, now about seventeen years of age. He was born with cleft palate and hare-lip. The latter was operated on in early infancy with success; and it was intended that the cleft in the palate should ultimately have been closed by surgical operation; but the patient refused to submit to the pain. The cleft is complete from before backwards, passing to the left in the front of the mouth—an incisor being there wanting, as is frequently the case.

No difficulties were presented in adapting a hard and soft palate to occlude the cleft. A thin rigid gold plate was fitted to the hard palate, and support was obtained

Fig. 119.

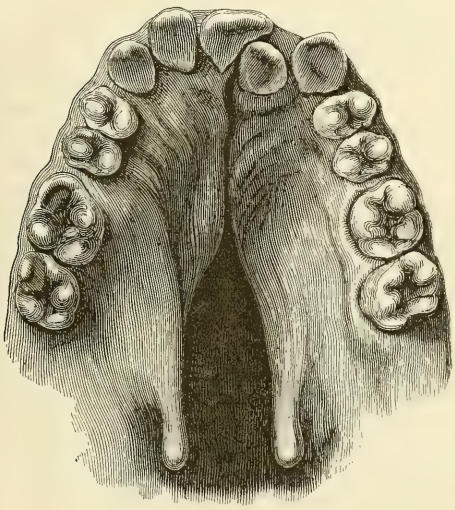
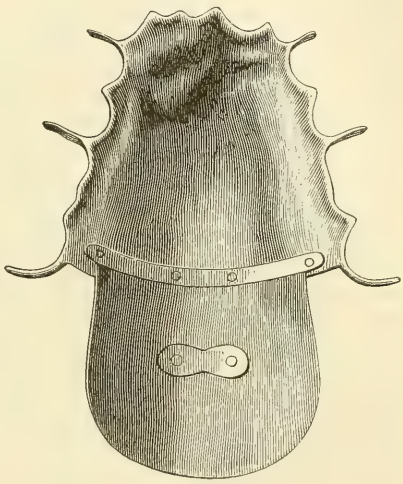
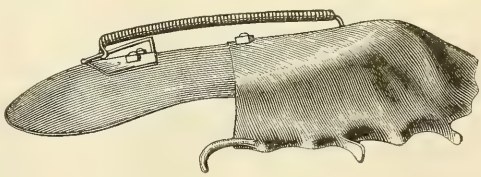


Fig. 120.



by clasps between the bicuspids and the teeth on either side, and to prevent the dropping of the hinder part, which is frequently troublesome, fine thin clasps extended round the back molars. The velum palati was replaced by thin soft vulcanised caoutchouc, which I always employ for this purpose. The accompanying illustrations (figs. 120, 121), showing the artificial palate as seen in face on the oral surface and in profile, render any lengthened description unnecessary. In adapting a soft palate it is necessary that the movable flap should be kept constantly in apposition with the pillars of the forces during their movements in deglutition, &c., and this is effected by means of an elastic spiral cord of gold wire, as seen in the profile illustration. This must be of the lightest possible character, as the power of the muscles to move the flap is very feeble. The same object is sometimes effected by doubling the thickness of the caoutchouc near the hard palate.

Fig. 121.



When a false soft palate is first introduced, it often produces tickling of the fauces and retching; and it answers well to employ a very small flap at first, and gradually increase its size till it amply replaces the deficient velum.

When the flap is made of soft caoutchouc it becomes sodden in time and loses its elasticity; but it is easily replaced, and an intelligent patient may do this for

himself. To obviate this objection, Mr. Parkinson,[1] who has had much experience in treating these cases, employs a thin flap of vulcanite; but this being stiff can hardly apply itself so closely to the pillars of the fauces; still, in effect, it is said to answer well.

In cases where large portions of jaw are lost from disease or accident, admirable restorations may be made, especially by means of vulcanite, and there is scarcely any part of the mechanist's art which tells with more effect on the patient's comfort. It is scarcely possible to put a limit to the variety and extent which these useful apparatus may reach.

S. James A. Salter.

[1] 'On the Adaptation of Artificial Palates,' *Lancet*, vol. i. 1867, p. 41.

DISEASES OF THE MOUTH, PHARYNX, AND ŒSOPHAGUS.

Inflammation of Tonsil. Quinsy. Cynanche Tonsillaris.

THE most common morbid affections of the tonsils may be thus classed :—

1st. Acute inflammation and abscess.

2nd. Chronic inflammation and enlargement.

3rd. Ulceration and sloughing.

1. *Acute inflammation* of the tonsils is generally preceded or attended by a distinct rigor or chilliness, and general feverish disturbance. Accompanying or following such constitutional irritation will be found pain in the fauces, and tenderness of the upper part of the throat in every effort at deglutition. The pain at first is not acute, but rather as if the parts had been bruised, and is diffused over the back part of the mouth and the pharynx. As the case progresses, the local mischief becomes more evident. At first a mere blush, the redness of the part becomes more marked. With the altered colour of the mucous membrane, tumidity of the tonsil will be observed, and before long œdema of the surrounding soft structures. With the increase in the severity of these local changes, it usually becomes evident that the mischief is confined to one side. But the evils of inflammation of the tonsil are not restricted to these symptoms alone, nor do the sufferings usually stop short here. Pains in the jaws and headache ; fever and loss of appetite ; often severe suffering in the part affected ; a loaded, creamy, and swollen tongue, with very foul breath ; muffled articulation ; great difficulty in swallowing, and fluids attempted to be swallowed escaping through the nostrils ; great fear of strangulation ; the patient frequently obliged to sit forward, or lie on one side, to allow the abundant saliva to drip into a basin, or drain away on a sponge—these are the conditions which mark the progress of the complaint, and comprise the chief characteristics of the attack. As the attack advances, the local examination of the mouth detects an increase of swelling, which usually runs forward in the substance of the soft palate, and on the side affected ; in aggravated cases even implicating the tissues which cover the hard palate as far forwards as the incisor teeth. With the increase of swelling, a central softening spot will sooner or later be detected, either with the eye, or more frequently at a comparatively earlier period, by an examination with the finger.

Much difference will be found, in different cases, as to the period at which pus is formed in an attack of acute inflammation of the tonsil, *i.e.* as to the period when the abscess may be relieved by incision. In some instances from forty-eight to sixty hours will suffice to insure such a desirable condition. In other cases, many days will elapse before matter can be detected by the point of the finger, or upon the thrust of a scalpel. During all this time the patient passes his days and nights in misery ; is not able to take any solid food, and but little fluid nourishment ; obtains very little sleep, and that little of a disturbed character ; has difficulty in respiration, caused by more or less œdema of the glosso-epiglottidean and aryteno-epiglottidean folds, and often greatly aggravated by fear, and a nervous horror of approaching suffocation. Inflammation in the acute form attacking the tonsil seldom terminates in resolution : as a general rule, it runs into abscess. This abscess will burst sooner or later if left to itself ; and when burst, the urgency of the symptoms will at once commence to subside. But if the abscess can be opened by the surgeon a day or two previous to what would otherwise be the spontaneous period of perforation, by so much will the patient's suffering be alleviated.

The causes of this form of inflammation appear to be generally associated with some disordered state of health, which renders the tonsils and throat especially susceptible to the influence of cold; for to direct exposure to cold may usually be attributed the immediate cause of an attack. But it will often occur that the patient has suffered from some constitutional disturbance previous to the commencement of the sore throat. Not infrequently he is of a gouty habit. Rigors and flushes commonly herald the attack, before the gland itself becomes the seat of inflammation. Abscess, the result of simple inflammation of the tonsil, irrespective of those cases which are complicated with scarlet fever, is a rare affection in childhood. It is seldom met with before puberty. It is not a frequent attendant on old age. It appears to be a disorder of youth and middle life.

It rarely occurs that both tonsils are simultaneously affected. But sometimes, after one tonsil has been the seat of suppuration, the opposite one becomes inflamed and runs into abscess. This, however, is infrequent. We occasionally meet with individuals who are subject to recurring attacks of inflammation of the tonsils and quinsy. These attacks occur every one or two years, often at shorter intervals; and then after a period this tendency appears to entirely subside.

Such conditions indicate especially, and prominently mark, the importance of constitutional treatment rather than simple attention to the local evil. It has constantly been found most serviceable, directly a patient has anticipated the recurrence of such an attack, to administer a stimulating emetic. The action of vomiting not only relieves by emptying the stomach, but appears also to have some beneficial action locally. In fact, individuals subject to such attacks, and who have adopted such a course of treatment, have expressed themselves satisfied that suppurative mischief has been warded off by recourse to an emetic in the very earliest stage of a sore throat.

As the attack is usually of a very debilitating character, an emetic of mustard is preferable, on every account, to one of antimony or ipecacuanha. Fomentations to the throat externally, inhalations of the steam of hot water pretty constantly, and a free purgation after the action of the emetic, should be the chief points of treatment. We strongly condemn the abstraction of blood, either locally or generally, either by leeches or by any other means. Blisters appear equally unnecessary, and are objectionable on account of the irritation and annoyance they entail on the patient. Mustard poultices appear to afford much relief in many cases; their application is often grateful to the patient's feelings; and by repeated application they can be made to keep up sufficient counter-irritation, without the inconvenience of producing a sore. A blister occasionally leaves a very red, irritable, and painful raw surface on the neck, which, added to the exhaustion following an attack of quinsy, may be a source of considerable distress.

This disorder is one that calls much upon the strength and vital powers of the patient. During the greater part of the attack, food is taken but sparingly, and that in a fluid form. It therefore behoves us to husband the forces rather than diminish them by heroic treatment. As there is much difficulty in swallowing, the less a patient is pestered with physic the less uncomfortable will be his day. At night it may be desirable to procure sleep, if he be restless; and for such a purpose a few drops of morphia by hypodermic injection will in all probability suffice. But the use of opiates in such cases is better avoided.

So much is the patient reduced by such an attack, that when the pus is evacuated by puncture, or escapes by an ulcerated opening, it will generally be found that some days of nutritious feeding are requisite before he regains strength and the substance he carried previous to his illness.

Local treatment is more open to discussion. Some writers advocate the free application of solid nitrate of silver to the surface of the inflamed membrane; but it is somewhat doubtful if any benefit is secured by this method of treatment. It is certainly attended by one disadvantage; it produces a good deal of local discomfort, a most disagreeable taste for some time, and gives rise to much hawking and spitting, until the superficial sloughs occasioned by its application are removed

from the inflamed membrane. We have not found that the application, under the acute conditions described, is followed by any satisfactory or beneficial results.

If the swelling of the tonsil be considerable, the surface very red, and the part very tender, and yet no very distinct indication of pus be present, it may appear sometimes advisable to make a deep puncture into the part to relieve congestion; or one or two incisions less deep. But as a rule, if the urgency of the symptoms be not great, it is far better to wait the formation of matter, rather than experimentally adopt an exploratory use of the scalpel. Every sensible practitioner studies the feelings of his patient; every good surgeon avoids the uncertain or unnecessary use of the knife. Incisions, if made, often occasion much suffering, are especially dreaded by some who have previously submitted to such treatment, and seldom appear to hasten the escape of matter. When, however, pus is detected or suspected, the part should be at once punctured.

There are some few precautions requisite, when any pointed or cutting instrument is used to open an abscess at the back or side of the mouth. The knife itself need only have, from its extremity, a cutting surface of about half an inch. Whatever knife be employed, it is best to protect the blade so as to cover its cutting edge up to this extent, by wrapping round it, from the handle towards the point, a piece of rag or plaster. A sharp-pointed straight bistoury is of all knives the most convenient for the surgeon's purpose.

In passing the instrument, when protected as described, into, or on withdrawing it from the mouth, the risk of wounding the lips or tongue is necessarily lessened—we may say is avoided, for no such accident should occur in proper hands. On puncturing the tonsil or abscess, an important precaution must be observed. The point of the knife must be kept towards the median line, especially after its point is buried in the soft tissues, and out of sight; on no account is the direction of the wound or thrust of the knife to be outwards. By due attention to this simple caution, all risk of wounding the larger vessels lying on the outer side of the neck is avoided.

The patient's head should be fixed, either against the back of a chair, or by the hands of a third person. A sudden movement while the knife is passing into the tonsil might lead to grave mischief, as the instrument might accidentally and unavoidably be thrust in a wrong direction.

The mouth is occasionally opened with some difficulty; and the tongue may be so much implicated in the inflammation that the patient cannot, by his own efforts, sufficiently aid the surgeon to obtain a good view of the swollen tonsil. Under such circumstances, a broad spatula gently applied to the surface of the tongue will expose the part sufficiently to permit the abscess to be punctured in a satisfactory manner.[1]

As soon as the abscess has been punctured, the pus generally flows freely on the withdrawal of the knife; sometimes so abundantly and so suddenly that it runs into the gullet; and from this circumstance, or from the fact that it is often very fœtid, it greatly nauseates the patient, sometimes to vomiting. Shortly after the escape of the pus, the patient usually becomes comfortable, expresses himself wonderfully relieved, and soon desires to partake of food. Convalescence is generally rapid and satisfactory.

As we have already said, occasionally, but rarely, the opposite tonsil becomes inflamed and suppurates. Under such circumstances an early tonic and stimulating course of treatment may be requisite; and the medical attendant must look for his

[1] A practical hint in passing may here be thrown out, on the best method of examining the throat generally. With many patients it is often a matter of some difficulty to gain a sight of the fauces. The tongue is pushed upwards directly the mouth is opened; and when the spatula is applied with the intention of pushing down the tongue, the patient immediately appears to resist its application with a steady and firm effort. *If, however, the spatula is, without the slightest weight, laid on the tongue, it gradually contracts and is drawn backwards, allowing a perfect view of the fauces.* No force or pressure is requisite on the part of the surgeon to effect this; the weight alone of the spatula appears sufficient to insure the object desired. This experiment has been constantly illustrated, on patients suffering from throat-affections, to our pupils.

guide to those symptoms which would indicate constitutional deterioration and physical exhaustion, to be met by generous diet and wine or other stimulants.

In the treatment of all cases of abscess of tonsil, there must be a certain amount of anxiety: but the anxiety as to the symptoms which precede the formation of the abscess is as nothing compared to that we may have to encounter when unfavourable symptoms are set up *after* the evacuation of the pus. In an unhealthy constitution ulceration may supervene upon the incision, and be followed by sloughing sore throat; or œdema of the surrounding soft tissues may arise, and travelling downwards around the larynx, pharynx, and œsophagus, terminate the patient's life in a few days. But fortunately these are the rarer evils following upon the evacuation of pus, the result of simple acute inflammation of a tonsil, or true quinsy; the usual history of which complaint is, that directly the abscess has burst or is opened, convalescence is speedy and perfect.

The sore throat of childhood is rarely acute inflammation of the tonsil ending in abscess. It is usually the symptom or accompaniment of scarlet fever, or partakes of that more frightful and fatal character known as 'putrid' or 'sloughing sore throat,' of which we shall hereafter speak. The latter is usually accompanied by enlargement of some of the glands of the throat or parotid. In quinsy the throat-glands are seldom affected, and if affected, not to any extent.

Several of the symptoms referred to above, as indicative of the formation of pus in an inflamed tonsil, are present to some extent under conditions which are apt to be mistaken for quinsy.

A decayed or broken tooth will often set up a considerable degree of alveolar inflammation, and be followed by abscess of gum or corresponding maxillary region. This condition occasions much difficulty in opening the mouth; the breath is fœtid; the tongue becomes very foul and loaded; there is great difficulty in deglutition, and pain of face on the side affected. But generally one marked difference exists between the symptoms of quinsy and an abscess originating in alveolar inflammation; when a tooth or a stump is the cause of the mischief, there is always more or less swelling of the *face*, and tenderness and swelling, especially over the *maxilla* affected. In quinsy, if there be external swelling present, it is not over the face or cheek; it is confined to the submaxillary region, and the neighbourhood of the parotid.

In all cases of inflammation, either within or external to the mouth or throat, the medical attendant should look with suspicious care to the condition of the mouth. There are few circumstances in practice more apt to be overlooked than the evils which arise from the irritation of decayed teeth.

2. *Chronic inflammation*, terminating in enlargement of the tonsil and thickening of its mucous surface, is a very common condition, more especially to be observed in children, and in young persons of both sexes under the ages from twenty to thirty. The tendency to this form of diseased action and enlargement is mostly observed in individuals of a strumous or lymphatic habit. The enlargement frequently commences as early as the second year of life, and has been observed to occur more especially in children who have been weaned when very young, or brought up by hand-feeding. Less frequently it does not show itself until towards the period of approaching puberty. It has a tendency to affect females in a greater proportion than males, though it is by no means an infrequent complaint in the latter sex.

The commencement of chronic enlargement of the tonsils appears to be unattended by any marked symptoms, local or general. Rarely is attention drawn to the condition of the part until either the thickness of articulation, loud snoring in sleep, or deafness, excites the mother's curiosity, or gives rise to anxiety, when an examination of the throat is instituted. Pain is never a symptom attendant on these swellings. The only local symptoms are those which necessarily arise from the mechanical encroachment of the tonsils, in the median line, betwixt the external oral and nasal apertures, and the internal apertures of the breath- and food-passages. The intensity of these symptoms will depend on the size of the masses on either side of the fauces.

The causes which produce this chronic enlargement of the tonsils are not satis-

factorily established. A careful inquiry into the history of a large number of cases has failed to detect any one specific reason to account for this diseased action. It does not appear to depend on cold, or insufficient nourishment, nor on want of cleanliness; for it will be met with in the children of the upper, as often as in those of the lower classes, and as often in those who are well provided and tenderly cared for, as in those who are the children 'of sorrow and acquainted with grief.'

This diseased action does, however, appear to affect in a larger proportion those children who have been brought up by hand or early weaned, than those who have been supplied for a sufficient time with the mother's breast-milk. The enlargement of the tonsils will also frequently commence on the convalescence from severe attacks of the various eruptive or other forms of fever. Most frequently, however, their growth is grafted on a strumous diathesis.

The forms under which enlarged tonsils occur deserve some attention. One of the most frequent appears to be a uniform globular projection on either side, to a greater or less extent. In this condition the swelling may cease to grow, and remain stationary for years, without inconvenience or injurious consequences. Or the glands may slowly and steadily increase in size, until their surfaces touch below in the median space and above either side of the uvula. In other instances, the tonsils appear to enlarge towards the soft palate, and often upwards past its free border, as well as downwards so low that the lower end is hid from view by the base of the tongue, and is only with care detected when the latter is well depressed; or the tonsil on one side only may be seen to project, a perfectly round mass, which is attached to the fauces by a thin pedicle of mucous membrane: occasionally an outgrowth may be seen, a pendulous tumour hanging from the natural position of the tonsil.

The surface of an enlarged tonsil is generally somewhat uneven, often very much pitted; the mucous membrane thick and velvety, and seldom without an increased vascularity. In many instances all these conditions may be observed in an aggravated degree. Often, superficially ulcerated spots are seen dotting the surface of the swelling; or, what is more common, small points of thick sticky sebaceous secretion will be observed, adhering to the mucous surface.

The fauces, especially when the enlargement of the tonsils is considerable, may often be seen covered with a viscid yellowish semi-purulent secretion; this clings to the posterior surface of the glands, or lines the walls of the upper portion of the pharynx.

When the enlarged gland projects to any extent above the soft palate, some degree of deafness is occasionally complained of. This concomitant symptom may depend rather upon the thickened condition of the mucous membrane, which, extending from the tonsils, run up to, and even encroach within, the Eustachian tube, rather than upon any actual pressure of the gland on the orifice of the tube.

Enlarged tonsils appear to be the result, not the cause, of constitutional derangement, provided they do not become large, or occupy much of the isthmus of the fauces. But if they increase in size, and thus lessen the passage from the mouth to the pharynx, many unpleasant effects may be detected. The voice is generally somewhat unnatural and muffly, and the pronunciation thick. So that enlarged tonsils appear to be a perfect impediment to the production of fine sweet notes in song, or clear sonorous tones in speech. The breath is often offensive; partly rendered so by the decomposing sebaceous secretion sticking in the orifices of the glands, partly by the thick semi-purulent mucus which clings to the fauces.

The enlarged glands are constantly liable to attacks of ulceration, and sometimes to acute inflammation attended by fever. If large in children, they produce more general effects on the system than in adults. They now interfere with perfect and free respiration. At night the child snores loudly; often awakes in his sleep, and as often in a state of alarm. In some instances the natural and requisite amount of rest is so interfered with that the child's health suffers. There is also frequently some little inconvenience in swallowing, and care is observed to be taken by the child that only small quantities of food be swallowed at a time.

If a section of a portion of an enlarged tonsil be examined carefully, it will be found, to the touch, firm in consistence, and somewhat elastic when pressed. The face of the cut surface will present several small uneven and irregular depressions, from which may be picked, every here and there, or squeezed out, small collections of sebaceous matter. The structure of the enlarged mass consists of condensed areolar tissue, which often runs like bands between and around the depressions above alluded to. The naturally soft structure of the gland is so condensed and firm, that it assumes the character of fibrous tissue intersecting the substance of the growth in every direction.

The accumulation of epithelial secretion within the ducts of the glands, occasioned by the obstruction of their orifices, is the explanation of the formation of the cavities seen on a section of the gland; for, as the secretion increases, and cannot escape through the obstructed orifices of the ducts, it collects in the latter, dilates them, and sets up chronic inflammation of the structure of the gland itself, which terminates in its permanent enlargement.[1] This secretion will frequently be observed to escape from the surface of the enlarged tonsil when it is firmly pressed between the blades of the vulsellum prior to removal.

The treatment of enlarged tonsils may be summed up in a few lines. Unless the voice be affected to such an extent that it becomes desirable to lessen or remove them; unless the disturbance to the sleep of the child be manifestly interfering with health; unless the breath be rendered fœtid or offensive by the secretion from the ducts; or unless some other cogent reason render it desirable to interfere with the mass—it is better to leave the tonsil in its slightly enlarged condition, without the application of any local or constitutional measures. If a child so affected be delicate, and the tonsils appear increasing, we prefer constitutional to all local treatment short of that of removal. In the early stages of enlarging tonsils, if detected, it would be best to administer tonics as a rule, as they certainly act beneficially as regards the health; and by so doing, as far as experience allows us to hazard an opinion, arrest the progress of the growth. At any rate, under a tonic treatment such enlargements frequently remain stationary. Steel-wine, muriated tincture of iron, citrate of iron, syrup of iodide of iron, and cod-liver oil, each according to the constitutional peculiarity, may be prescribed with safety, and taken with evident benefit for many weeks or months. We need hardly caution the reader on the importance of attention to diet; and with very weakly children, sea-bathing is of the utmost advantage.

Local applications are frequently recommended, and too constantly adopted. Nitrate of silver rubbed over the surface, or points of nitrate of silver run into the substance of the gland; sometimes nitric acid carefully applied to portions of it; stimulating gargles; and a variety of troublesome and useless applications, have had their advocates for the arrest or removal of these masses.[2] An examination of a portion of a gland removed by excision will show such structural changes, such a fibrous thickening of the finer areolar tissue, that it appears a useless waste of time and material to attempt to procure absorption of such dense tissues. Nothing short of an actual slough can do good, if caustic be used; no stimulating application can offer much hope of acting on such a structure; it is therefore best not to waste time or inflict pain by having recourse to such useless local measures. If constitutional treatment does not arrest, and local treatment be requisite, removal by guillotine or knife of a portion of the gland is the speediest, and, in our opinion, the only efficient remedy. The surgeon can remove all that is necessary in a few seconds; and the patient will be entirely rid of the consequences within a week after.

When the glands are so large that some portion must be removed, to relieve the symptoms of discomfort or distress from which the patient suffers, the operation is

[1] Kölliker has given a minute account of the pathological conditions of the tonsil, and the abnormal secretion of the gland under such changes; but as any transcript of his investigations would not add to the practical importance of this subject, we beg to refer those interested in the question to the original (*Manual of Human Histology*, vol. ii. p. 30, Sydenham Society).

[2] The use of nitrate of silver persevered with, in a case known to the author, produced considerable permanent discoloration of the skin.

simple enough in adults, but may be somewhat troublesome when necessary in a young child. Under the latter circumstances it will be found advantageous to place the patient sufficiently under the influence of an anæsthetic to enable the operator to introduce the guillotine. The removal of the necessary portion of the gland is then easily effected.

In the adult there is no difficulty in the operation, and the guillotine may be used without the aid of an anæsthetic. If both tonsils be enlarged, and this is usually the case, there is no objection to a portion of each being removed on the same day. With children it is preferable to do so, as the fear of an operation is much greater when a child has had any experience of a previous one. But in an adult it may be left to the discretion or wishes of the patient, whether the operation be completed at once or at a subsequent period. If the tonsils are very large, it is always advisable to take away a considerable portion of each. But it is by no means requisite to remove the whole of the projecting mass. If half of the mass be removed, and the cells thus laid well open, what with their becoming emptied, the relief occasioned by the incision through parts chronically inflamed, and the subsequent contraction of the cut surface by cicatrisation, the portion that is left shrinks and sinks into the side of the fauces, to give no further trouble to the patient.

After the removal of the mass, the patient generally suffers but little; or rather as one affected with slight sore throat. The precaution to be given is, to use soft food, and to avoid exposure to cold for a few days, when the cut surface will be about healed. Hæmorrhage rarely follows to any troublesome extent on this operation; but it may, and sometimes does occur. The surgeon, always anxious to avoid such a contingency, should take the precaution not to draw too much of the gland through the aperture of the guillotine. This may be regulated by so adjusting the fork of the instrument that it shall not project very much from the aperture when the cutter or knife is thrust home. Not more than half of the mass need be removed, and even as much as this only when the tumour is of considerable size. Such a portion will always be found sufficient for the ultimate relief of the patient, and the removal of all the previous disagreeable symptoms. In the practice of the author, such a proceeding has never been followed by troublesome hæmorrhage. Should hæmorrhage occur, iced water as a drink, or the mouth kept open for a time, may control it; or digital pressure may be requisite.

In children, hæmorrhage may be suspected only after it has continued some time, from the cheeks becoming pallid, and the little patient showing signs of faintness. If, on examination, any distinct vessel is seen to bleed, a ligature can be applied with a little care; or recourse must be had to pressure, if the bleeding is from the general surface. Occasionally the enlargement of the tonsil assumes a pendulous form, so that the greater portion of the mass hangs down behind and below the roots of the tongue. In such cases it will be found easier to remove the growth by seizing it with a vulsellum, and cutting off as much as requisite with a blunt-pointed straight bistoury.

We need only refer to the proposal to remove enlarged tonsils by the application of ligatures, to condemn the plan of treatment as tedious, painful, and productive of much offensive discharge until the slough separates.

3. *Tonsillitis maligna.*—Ulceration of an acute form attacking the tonsils, and rapidly running into sloughing of the fauces, is a very grave—often a most intractable—affection; and as rapid as it is unmanageable.

Sore throat is the first symptom complained of, and with it the patient probably expresses himself as feeling ill. Rigors, followed by feverish disturbance, will generally supervene. The tonsils will soon be observed to be of a dusky red colour, and swollen; and the surrounding soft tissues and uvula are already œdematous. There will generally be much pain, and some difficulty in deglutition. Patchy shreds of grey or yellowish membrane appear embedded in the surface of the tonsils. These, after a time, spread, unite, and become deeper, until a considerable portion, if not the whole, of the soft palate may become implicated in the spreading mischief. The discharge which accompanies this form of slough escapes freely from the nose; for, as

the havoc spreads, the passage of even fluids to the throat is rendered difficult, and is often entirely intercepted by the œdematous state of the cellular tissue around the root of the tongue—so that liquids taken by the mouth are rejected through the nostrils. The character of the discharge is usually most offensive and intolerable.

If the patient survives, large sloughs separate from the parts attacked, and a considerable granulating surface may soon be observed, marking the havoc of the disease which has passed. In this havoc the whole of the uvula, and a considerable portion of the soft palate, have been seen to disappear, the patient's health being subsequently perfectly restored; though there remain for life the permanent defect, the alteration of the voice, and the inability to articulate distinctly—the results of the local injury to the soft palate.

In the greater portion of severe cases of malignant sore throat, the probability is that they are specific, or only a type of the severer forms of scarlet fever. But still the surgeon's experience may be sometimes advantageously referred to in some of the stages of such cases; and for this reason we have taken a brief notice of them.

As in sloughing of other tissues, so in that of the throat, under all circumstances a stimulating and tonic treatment must be pursued; wine must be freely given. The internal use of opium, carefully administered, is generally attended by most satisfactory results. It first seems to do good by modifying pain, and this enables the patient to swallow more readily and easily than he would do without it, and consequently he is able to partake more freely of nutritious food. But, as in ulceration and sloughing of other parts, so in this class of cases, it certainly seems to influence the morbid action of the parts, and to help in arresting the process of destruction. With children it is best administered as laudanum; its effects must of course be carefully watched, and its use withheld as soon as any drowsiness manifests itself. The muriated tincture of iron is also a most useful medicine in such cases, and may be ordered with benefit in full doses; diluted with syrup it has the advantage of being small in bulk and not unpleasant in taste, a desideratum of no small importance when a child is the patient.

The local treatment in these cases is a matter of much importance. The author has found most benefit from sulphurous acid applied in the form of a warm spray every hour or oftener for a minute or two at a time, while the patient is awake; and persevered with until the sloughs separate, and healthy granulation is established. The spray is easily and readily used, it is most cleanly, not at all disagreeable, if not too strong a solution, but rather comforting to the patient, and is notably the most efficient disinfectant applicable under such circumstances.

The fœtor in all such cases is generally very marked and distressing. The room should be kept thoroughly ventilated, and a liberal supply of a solution of chloride of lime or soda placed in different parts of it. The occasional use of the sulphurous acid spray carried about the room will also help materially to improve the state of the chamber.

A superficial and less severe form of ulceration of the tonsils is a very common occurrence. 'Ulcerated sore throat' is a term so familiar, and a condition so well understood among the more industrious and often over-worked students of our hospitals and dissecting-rooms, that it requires but little description here. Pain and some difficulty in swallowing; a creamy tongue; soft, weak pulse; pallid face; loss of appetite, and often loss of sleep; much languor and pains in the limbs; tonsils congested, and somewhat swollen; small, irritable, superficial, and scattered ulcers on the fauces and tonsils; urine often loaded with phosphates: such are the chief symptoms found to accompany one of these attacks.

The treatment is well understood. Change of air; a stimulating gargle; a slight aperient if requisite (mercurials, however, to be generally avoided); the internal administration of bark and ammonia, and a nutritious fluid diet, with a few glasses of wine daily, may be said to sum up all that is necessary. Convalescence is generally satisfactory under such treatment. A mouth wash of the permanganate of potash is also most agreeable in such cases; or as a gargle, it rapidly renders inodorous offensive discharges. It may with safety be used largely as a gargle or wash in all throat affections.

'Relaxed uvula' is by no means an uncommon complaint. The term does not quite describe the actual state of the parts in their altered conditions; for the uvula may be thickened and not increased in length. Under such circumstances it occasions but little annoyance, and seldom requires attention. Or it may be lengthened without being thickened, and this is the most common evil; and then surgical interference is necessary.

The increase of size, or the elongation, appear to be as independent of the condition spoken of under the name of enlarged tonsil, as the two conditions are of each other.

The increase of size is usually accompanied by a thickened state of the mucous membrane, and often a slight tenderness of the part. Though the thickening may remain, the tenderness after a time will subside; and then the part is left in a permanently enlarged, though not in a persistently enlarging, condition. It seldom increases to an inconvenient size.

Should the symptoms which attend the first increase of size be troublesome, the simplest local remedy is to smear the surface once or twice with solid nitrate of silver; and constitutionally use such measures as the general condition of the patient will indicate to the observant practitioner. Usually the condition is one which is benefited by tonics. Elongation of the uvula appears to be generally dependent on an excess of mucous membrane; for the azygos uvulæ muscle does not often form any part of the increased growth. The mucous membrane may extend an inch beyond the extremity of the muscle, and hang down like a thin narrow slip of tissue, ending often in a point. When of this length, it extends behind the root of the tongue lower than it should do, and the point rests over or even enters the aperture of the larynx. This contact with the larynx is a constant source of irritation, and occasions a troublesome cough. Frequently the tickling of the fauces and pharynx produces nausea and a tendency to vomit. Patients sometimes, after food, on coughing, reject a portion of the meal taken. These symptoms are often attributed to other causes until the throat is examined and the condition of the part detected.

This elongation of the uvula is not often seen in children, but most frequently in the period of middle life. It is seldom observed in old age.

The remedy is as simple as the relief is certain. Removal by knife or scissors is the only treatment to be entertained for a moment. The point of the uvula is to be seized with a long pair of forceps, and cut off so near to the base as to leave the part of its natural length.

The patient may feel the throat a little sore for a day or two, but no treatment beyond ordinary care will be requisite. The uvula is very apt to be implicated in inflammation about its neighbourhood; and constantly, under such circumstances, becomes œdematous. This condition, however, is seldom confined to the uvula alone, but implicates usually the soft palate and adjacent tissues. It depends on erysipelatous or diffuse inflammation of the cellular tissue—a dangerous and often fatal affection, which will be found treated of in the essay on Diseases of the Larynx.

Cancerous ulceration of the soft palate or tonsils is not frequently a primary affection. Generally it is continuous with disease originating about the back part of the gums, cheeks, or tongue, and in either case offers no hope of benefit from treatment. The sufferer usually fails rapidly in health, emaciates, and dies early after ulceration is detected. Often death is fortunately accelerated by sudden and profuse hæmorrhage, the result of perforation of some artery implicated by the ulceration. Sometimes such hæmorrhage may be fatal though the disease be not at all extensive, as occurred in the case of a distinguished member of our profession.

Tumours of the soft palate and fauces are sometimes met with of a non-malignant character, and independent of inflammation. These usually consist of, 1. Fibro-cellular tissue; 2. Cysts; 3. Warty growths and other growths of a non-malignant character, occasionally met with attached to the soft palate, and growing apparently from the mucous membrane.

It has occurred to the author to have to remove such growths in two instances in young women; in both the growths commenced without being noticed, and were accidentally discovered; they were readily removed, and were found to consist of simple epithelial structure.

1. The small fibro-cellular tumours usually assume a pendulous character. They are painless; usually attached to the free border or upper surface of the soft palate; and are generally only detected when they become locally inconvenient by dropping down below and behind the root of the tongue. They are usually somewhat slow in their growth, and as they increase in size become more pendulous, often supported by quite a thin pedicle. They can be readily removed with scissors and forceps.

2. *Cysts* of these parts commonly contain thin glairy fluid, generally the result of obstructed muciparous ducts. They are readily treated by a simple free incision and a subsequent application of solid nitrate of silver, or a drop or two of nitric acid applied on a probe to the interior of the cyst.

Sebaceous cysts are occasionally found in the substance of the soft palate. They may be recognised by their yellowish white colour showing through the mucous membrane. They only require to be laid open, and the interior of the cyst touched for a day or two with a probe nipped in nitric acid.

The author was consulted some few years ago by a gentleman who had a tumour occupying the right side of the fauces; it had so much increased in size since its commencement that the uvula was pushed some way towards the left tonsil. The growth was about the size of a small orange, was lying immediately beneath the mucous membrane, and appeared to have sprung from the wall of the upper portion of the pharynx. It occupied the position of the right tonsil, and quite filled up the opening of the fauces on the right of the uvula, while in front it pushed forward the soft palate on that side. It had been growing some four years, as far as the patient could judge, and was beginning to give trouble in deglutition. It was somewhat elastic to the touch, and the mucous membrane was freely movable over it. It also appeared fairly movable at its base. It had been pronounced by some to be a cyst, but the introduction of a trochar proved its solid nature. The patient consented to its removal, which was effected without much difficulty. A free incision was made through the mucous covering, which was readily separated from the tumour by passing the finger around it. And thus the mass was isolated from its surrounding attachments with the exception of one small part at its upper and outer surface, where it appeared more firmly attached to the corresponding wall of the pharynx. This was, however, easily cut through and the mass removed. It turned out to be an enchondromatous tumour, easily breaking up into pieces. As to its origin, it occurred to the author that possibly it might have originated in a growth from the inner surface of the parotid gland which had made its way through some of the muscular fibres of the upper constrictor of the pharynx, and then gradually increased till it attained the size when removed. There was no recurrence of the growth when the patient was seen three years after the operation.

Abscess of the soft palate is rare; but it should be opened as soon as detected. It generally gives no subsequent trouble.

Congenital Fissure; 'Cleft Palate'; and Defects of the Palate from Disease or Accident.

The occurrence of congenital fissure of the palate is so frequent; the evils which result from it are so marked; and the life of an infant is so often endangered and not unfrequently cut short when the fissure is extensive, that a consideration of the treatment which proposes to overcome or to modify the defect may truly be said to form a subject worthy of notice in a work on Practical Surgery.

The investigation of the early development of the mouth explains the various degrees of extent which congenital fissure of the palate *may* assume, and such as *are* constantly found to exist in the new-born infant.

To Mr. Goodsir[1] the profession is indebted for an accurate account of the develop-

[1] *Edinburgh Med. and Surg. Journ.* vol. li. p. 1.

ment of the mouth; and although, in a practical work of this character, it would be intrusive to enter very fully into such a subject, we are compelled to take a cursory view of the changes which occur in the upper jaw *in utero* in order to appreciate the causes of the various deformities which affect it.

In a fœtus of about the sixth week examined by Mr. Goodsir, the cavity of the mouth, nares, and pharynx formed one undivided space; the palate was entirely wanting; the outline of the future alveolar ridge was evident. With the particular description of this latter process we need not trouble the reader; but from the inner margin 'a thin semi-transparent membranous fold passed backwards on each side, attached externally to the sides of the capacious bucco-pharyngeal cavity, bounded internally by a free edge, opposed to its fellow of the opposite side, and terminating posteriorly on the lateral walls of the pharynx.

'These folds constituted at this period a partial division of the large common nasal, buccal, and pharyngeal cavity into a superior and inferior compartment.

'The upper wall of this common cavity was smooth and flat posteriorly; but anteriorly it was contracted, and terminated in a longitudinal bar (the future septum nasi), which ran forwards to be attached to the superior surface of a horse-shoe lobe [1] (described) at the median line (in front) and to the other parts in that neighbourhood.

'Under the bar a deep cavity was seen, which communicated with the exterior of the face by two small foramina (the orifices of the nostrils), which constituted at this period the whole external nasal organ.'

In an embryo of about the seventh week, next examined, 'the cleft had slightly diminished, but was still of sufficient width to display the whole of the undivided nasal cavity.'

In an embryo of the second month 'the cleft of the palate had diminished, existing only as a small angular deficiency in the pendulous portion, or soft palate.'

In an embryo of the tenth week the anterior portion of the palate 'had thrown itself into folds; and there was an indistinct uvula.'

The uvula 'was well marked between the eleventh and twelfth weeks.'

If an examination be made of the bones of the palate previous to, or not later than, the sixth month of fœtal life, in addition to the median suture between the palate-processes of the superior maxillary bones, a distinct oblique suture will be observed, which starts from the median suture a little behind the alveolar ridge, runs outwards and forwards through the latter, and terminates on its anterior aspect, at the point subsequently marked by the interval between the lateral incisors and canine teeth. So that in fact the under or palate-surface of the superior maxilla is at this period of life (third to fifth month) marked by this suture, as if the bone had been at an earlier period divided into two portions: one, an anterior small 'intermaxillary bone,' or 'os incisivum,' as it is termed, and which carries the incisor teeth; and a posterior, the larger portion, in the alveolar process of which are developed the canine, bicuspid, and molars. This suture disappears, under healthy natural development, soon after, or even before, birth.

The variations met with in the deformities of the palate appear to be distinctly due to an arrest in the development, already described, of the upper jaw and soft palate—an arrest which occurs from some unexplained cause, at an earlier or later period, but probably within the first twelve weeks of fœtal life, in accordance with the extent of the deformity. The variations may be thus classed:—

1. The most extensive; a double cleft of the alveolar ridge [2] with a fissure from each cleft running backwards and inwards, and joining together immediately behind the intermaxillary bone, and being continuous with a median fissure through the entire hard and soft palate.

2. A single cleft of the alveolar ridge on one side or the other of the median line, running back into an entire cleft of the palate.[3]

[1] This may be taken as the future 'os incisivum' or intermaxillary bone.

[2] The cleft of the alveolus under such circumstances is often complete throughout on each side from front to back, and from the mouth into the nostril.

[3] Instead of the alveolar ridge being cleft, as described, in this variety, there may be only

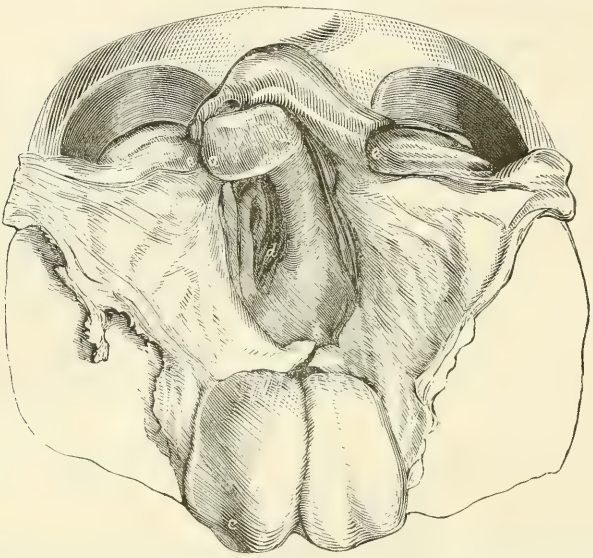
3. The alveolar ridge entire; the cleft of the palate commencing immediately behind it and complete backwards.

4. The cleft running as far forwards as the middle of the palate-processes of the superior maxillæ, or through the palate-bones only.

5. Fissure of the whole of the soft palate, or only implicating the uvula.

Between the extreme of one and the other every variation of extent may occur.

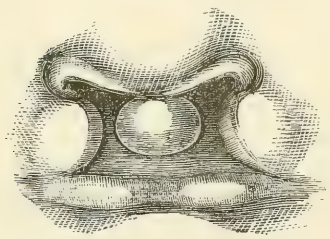
Fig. 122.—Complete cleft of the Palate with double Hare-lip. (From a preparation in the Museum of St. George's Hospital.)



a, the intermaxillary bone; *b*, the septum nasi; *c*, the tongue; *d*, the cleft into the nasal cavity; *e e*, the separated halves of the upper jaw.

Occasionally, but rarely, a congenital defect is met with in the median line, either as a circular or oblong opening: in front and behind it the palate is closed. These openings most frequently occur in the palate-bone; and usually, when such an opening exists, the median line of union is very plainly marked on the under-surface of the soft palate and the uvula by a distinct straight thin cicatrix, showing the union of the sides of the soft palate completed, although the palate-bones, in consequence of their defective development, were unable to perfect the naso-oral septum in their immediate neighbourhood.

Fig. 123.—Double Hare-lip, showing the intermaxillary bone attached to the septum nasi.



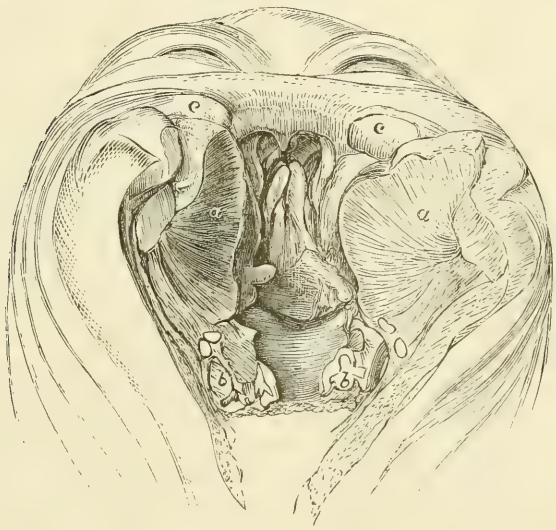
It will be observed in some cases that the gaps through the alveolar ridge are excessive, *i.e.* complete from mouth to nostril; while in other cases they are but partial. When excessive, and when the fissure is complete through the hard and soft palate, the intermaxillary bone, or 'os incisivum,' becomes often widely separated from the superior maxillæ, and forms a nodule more or less round (the horseshoe lobe of fœtal life already described), which is supported by and attached to the anterior inferior termination of the septum nasi. This nodule may be more or less prominent, and is occasionally so much so that it appears simply to be stuck on the tip of the nose. Under these circumstances it is but little covered with skin, which is merely a prolongation from the integument above, and unconnected with the integument of the lip on either side.

a notch, or a large or small foramen through its base. The cleft has been partially closed by growth, or by pressure of the lip.

If the nodule be dissected between the sixth and eighth month after birth, in it will be found not only the temporary incisors, but also the germs of the permanent ones; not always the lateral, but invariably those of the central incisors. Occasionally those of the lateral will be found, though they frequently are sacrificed by the freak played by nature in permitting these gaps to occur.[1] Whenever a single fissure occurs through the alveolus, the gap will not be found in the median line, but, as a rule, on one side. We cannot satisfactorily explain this. It may depend on the peculiar conformation of the upper jaw and its early development. We would refer those interested in the subject to the further consideration of Mr. Goodsir's observations.

It is rare indeed that the infant born with extensive cleft palate and alveolus has not also the upper lip notched or fissured opposite to the defect in the bone. Usually, if not invariably, when the cleft of the alveolus is double, the cleft of the lip will correspond; when single, the lip is usually similarly affected. But when the cleft of the alveolus without cleft of the palate occurs, hare-lip is not always present.

Fig. 124.—Fissure of the Palate in the median line. (From a preparation in the Museum of the Royal College of Surgeons.)



a a, the tongue divided in two in order to expose the cleft; *b b*, the larynx similarly divided; *c c*, the two halves of the upper lip and jaw, between which is the cleft opening freely into the nasal cavity, the intermaxillary bone being absent.

In complete cleft of the roof the attachment or disposition of the septum nasi varies in different cases. As a rule, the more extensive the gap the greater the deformity. The septum will often be seen, in complete cleft of the palate, to be continuous by its lower border with the margin of one or other of the edges of the cleft; in which case one of the nasal cavities is so far shut off from the mouth, while the other is open to it. In other instances the septum dips down between the nasal fossæ almost as low as the edges of the fissure, and terminates in a free defined border, unconnected with the superior maxillæ; or it will be sometimes seen bent or

[1] When this nodule is very prominent, and appears likely to interfere with the success of an operation for the closure of hare-lip, we would strongly urge the importance of depressing it forcibly rather than removing any portion or the whole of it. It may be forcibly broken and depressed, and made to fit in the gap between the superior maxillæ, where it will almost invariably become firmly fixed, and subsequently have shooting out from it some or all of the incisors. If these be defective, the surface of the bone forms an excellent rest for a plate to carry artificial teeth. If the os incisivum be removed, the superior maxillæ are certain to be more or less drawn together by the action of the upper lip, the latter becomes much flattened, the upper portion of the mouth much narrowed, and the gap in the alveolar ridge never entirely closed.

folded on itself, its edge turned up to one side, with one of its lateral surfaces facing downwards.

These different conditions of the septum have no practical bearing on the subsequent treatment of the case. Rokitansky alludes to fissures of the palate caused by the absence of the os incisivum, and attended by fissure of the upper lip *in the median line*;[1] but he does not state that he had met with an example of this rare deformity. Sir Wm. Fergusson,[2] in alluding to the occurrence of cleft in the lip, says: 'Doubtless it has been named hare-lip from a certain resemblance to the fissure in the upper lip of the hare; but in the human subject it differs in this peculiar feature, that it never is in the mesial line, as it always is in the hare.'

Rokitansky only alludes to the occurrence of the fissure in the median line, but gives no details of any peculiarities which might be supposed to accompany such a defect. Sir W. Fergusson had apparently not met with a case; and the deformity is no doubt most rare. But a specimen such as Rokitansky refers to—the result of absence of the os incisivum and fissure in the median line of the upper lip—may be seen in the Museum of the Royal College of Surgeons in London. In this preparation (of which no history is recorded) the fissure of the upper lip is in the mesial line, the result of a great gap, as if a large portion of the middle of the lip were destroyed; the os incisivum is altogether deficient, no vestige of it being present; and the cleft of the hard and soft palate is complete.

But there is this additional interesting feature in this remarkable specimen; the anterior nasal apertures are wanting. The explanation of this latter defect appears to be simple. The os incisivum being absent, the septum nasi has nothing to attach itself to in front and below. The anterior orifices of the nostrils are therefore defective; the apex of the nose does not project; the alæ are flattened; and as the *entire* floor of the nares is deficient, and the anterior lower portion of the septum terminates by a free edge, the would-be anterior orifices of the nostrils are merged in the median gap of the lip, alveolar ridge, and mouth. Probably the child was still-born, or died soon after birth.

We do not attempt to enter into an explanation of the causes of cleft palate. Observation has not thrown any light on what may reasonably be considered merely an arrest of development at some period of fœtal life prior to the fourth month. Thus much, however, we may state, that in the isolation of the os incisivum from the superior maxillæ we find an approach to a somewhat similar arrangement in the teeth of the upper jaws of certain animals, in whom the incisors are separated by a distinct interval or gap from the bicuspid or lateral teeth.

Cleft palate and cleft lip are frequently found to affect more than one member in a family; but we cannot state that congenital cleft of the mouth or lip is a common occurrence, as a result of hereditary transmission. It is rare to observe both the parent and offspring affected on either side, although brothers and sisters of the same family constantly present different conditions of the deformity.[3]

Practically, the more extensive the cleft in the palate, the more upright will be the surfaces forming the sides of the gap. Usually the cleft in the palate is narrower in front, and widens towards the velum. But much variety will be found if a large number of cases are compared with each other. In some the gap is wide; in others, though complete from alveolus to uvula, the gap will be narrow. When the cleft is only partial, the less it encroaches upon the hard palate, the more natural will be the arch of the roof in front; and the sides of the partial cleft will also somewhat partake of the natural curve of the arch rather than run upwards, as is almost always the case when the cleft is considerable, or extends entirely through the palate and alveolus. When restricted to a small portion of the palate-bone and the soft palate, it by no means follows that the cleft is equally narrow in proportion; on the contrary, it will be frequently found that these partial clefts are very broad; so much so in some instances that the palate processes of the palate-bones and the sides of the bifid soft

[1] Rokitansky, *Pathological Anatomy*, vol. ii. p. 3. [2] *Practical Surgery*, p. 584.

[3] How far civilisation or crowded populations may influence congenital deficiencies in the human subject is a question to be hereafter worked out; but it is a curious fact that most of the young of the lions caged in the Zoological Gardens of London are born with defective palates, and consequently die soon after birth. As far as our limited means have enabled us to ascertain, it appears that it is not usual for the lion family, in a state of confinement, to have their young similarly affected, but that this congenital defect is restricted to the lions kept in the Regent's Park, as if some local influence were instrumental to this end.

palate appear to be almost wanting. These partial clefts in some few instances are so broad that operative interference is unadvisable, as there would not be, even of the soft palate, sufficient tissue to allow of the edges meeting, or being approximated without undue tension.

The primary effects of cleft palate, when extensive, are sufficient to create much necessary alarm for the safety of the infant's life. If hare-lip exist, with double or single cleft of the alveolus, and a broad cleft of the roof, unless the infant be supplied *plentifully* with its mother's milk from the first, it will probably soon sink from exhaustion. It is very difficult in such cases to introduce a sufficient quantity of milk into the stomach, to insure an amount of nutrition equal to the maintenance of life. The mother's milk is the only food that should be given for the first six or eight weeks. In all cases of cleft palate, the infant is unable to suck the nipple; for as the naso-buccal septum is wanting, the child cannot create with its tongue a vacuum in the mouth, and is therefore unable to draw milk from the ducts of the mammary gland. There is no alternative but to hand-feed such an infant. It will be found most convenient to place the infant in the upright posture while it is fed; this position allows the fluid nourishment to flow backwards and downwards into the pharynx, instead of running into the nares and out of the nasal apertures, as occurs when the child is fed lying on its back.

After a few weeks of this careful nursing, the child will begin to take its food with greater facility; and as it grows older, with a freedom which is somewhat surprising when the amount of defect in the palate is considered. But as these children have often a very great struggle for life in the earlier weeks, we repeat that *breast-milk should be alone given.* The milk should be drawn from the mother or nurse, and given with a bottle, to which a smooth flat ivory pipe is attached; its orifice should be small; and the flow of the milk through it so managed that suction is not requisite, but at the same time the current be gentle, and easily regulated by the inclination of the bottle in the nurse's hand; or a small piece of sponge dipped in the milk and then placed in the mouth will often be found to answer equally well, but of course the process requires to be repeated as often as the milk is sucked out of the sponge; great care is requisite and judgment necessary in supplying sufficient nourishment to the infant, and for this purpose an experienced nurse is most desirable. So much as regards the early nursing of a child born with cleft palate. The question now to be considered is, the surgical interference by which the condition of the mouth may be improved, and at what age such treatment may be safely and successfully adopted. In the first edition of this work, we stated our opinion that it was not desirable to attempt to close the fissure of the palate, by operation, during infancy, and that such treatment were better deferred to a later period, when the patient was old enough to judge for himself whether he would prefer to wear an artificial palate for life or have the fissure permanently closed, and was moreover of an age to submit to an operation without the aid of chloroform.

Since that time, however, the experience of others, as well as our own, has induced us to materially alter our opinions and practice in this respect.

Mr. Thomas Smith, of St. Bartholomew's Hospital,[1] was, we believe, the first to introduce the use of chloroform in operations on the palate in children; under its administration clefts of the palate may be readily and successfully operated on in childhood at a very early age. Prior to the publication of his observations, other surgeons had succeeded in closing such clefts in young children;[2] but Mr. Smith, in addition to the information given to the profession, that chloroform can be satisfactorily employed in such operations with considerable advantage to the surgeon, has also aided still further to perfect the steps of the operation, and render it one of comparative ease and simplicity, by the introduction of his ingenious gag for keeping the jaws asunder while an operation is being proceeded with.

[1] *Trans. Med.-Chir. Soc.* vol. li. p. 79.

[2] In one case operated on by M. Billroth of Zürich, a cleft extending from the lip to the uvula was closed by successive operations before the age of twelve months. See Billroth, in Langenbeck's *Archiv*, vol. i. p. 657.

The real object of the operation of closing the cleft in the palate is to enable the patient to articulate hereafter plainly and intelligibly—*not* to enable the child to take food. An infant with extensive cleft, when first born, has often some difficulty in taking sufficient to satisfy its wants, or to nourish it, as it would be nourished were its palate perfect; but usually this difficulty is overcome in a few days, and if proper care be taken the infant usually thrives. An operation at this period is therefore not requisite, nor is it desirable: the loss of blood the infant would sustain in such an operation would be attended by great risk to life; the tumefaction and tenderness of the mouth subsequent to the operation would be sufficient to interfere greatly with its taking a proper amount of nourishment; and both the loss of blood and the insufficient quantity of food might materially interfere with the union of the flaps, even supposing the infant survived under such circumstances. A very slight loss of blood may prove fatal in the very young, especially in one of a puny delicate nature, such as children with cleft palates often are; but the loss of blood in an operation for cleft palate is often severe, more especially when the hard palate is dealt with: great risk would therefore be run by early resort to this operation, and fatal results would inevitably occur in many cases.

Dr. Ehrman,[1] in a very interesting and complete memoir on the subject of cleft palate, mentions the death of four cases, in infants in whom the operation on the hard and soft palate had been attempted—one of four days old, one of five days, and two of two months each. As a child does not commence to articulate, as a rule, before twelve months old, nor to pronounce many words before two years of age, there is no imperative haste for the adoption of the operation before that age, nor is there any advantage to be gained by its earlier completion. The reasons are strong against its performance prior to this period of life; some few months later the child is in a much more favourable condition to undergo the operation, and less liable to succumb from the effects of loss of blood. Under all these circumstances it is safer, and ultimately equally efficacious for the improvement of the articulation, to defer all operative interference until the child is two or three years of age. With the use of the gag and the administration of chloroform, the operation may then be undertaken without hesitation, can be readily performed, and in a large majority of cases will be successful.

As the most simple form of cleft is that confined to the velum or soft portion, we propose to consider, first, the method to be adopted to close it, irrespective of any extension of the fissure into the hard palate.

Should the uvula alone be bifid, very little is requisite to secure union of its opposed edges; and indeed, if the voice be not affected, nor the cleft detected by any peculiarity in the articulation, it is better not to meddle with the fissure. Cleft of the uvula, however, does usually affect articulation. The surgeon need have no hesitation in undertaking the operation. The opposed edges of the bifid uvula should be pared, care being taken to carry the incisions on either side a little way into the soft substance above, so that they meet in the median line in front of the commencement of the cleft; care must also be taken that the mucous membrane at the edges is sufficiently removed to ensure two raw surfaces being adapted to each other. The surgeon should first seize one point of the bifid uvula with a pair of long spring forceps, and draw it forwards, transfix it near its inner border with a narrow sharp knife on a long handle, and freely cut upwards and downwards, in order to remove the mucous membrane along the whole of its inner margin. A similar proceeding on the opposite side completes the use of the knife. Two or three sutures of horsehair or fine silk will be sufficient to approximate the edges and keep them in place.

Whether the fissure implicates merely the uvula, whether it be confined to the whole extent of the soft palate, or whether it affects the whole of the hard and soft it is best, on the part of the operator, to commence by paring the edges of the cleft in its entire extent before proceeding to any other step necessary in the completion of the operation. Great care is requisite to free the edges sufficiently of mucous membrane; it is better to remove a little more than necessary rather than an insufficient

[1] *Etude sur l'Uranoplastie.* Paris, 1869.

surface. The success of an operation will not be interfered with by attention to this precaution, whereas the result will surely be to some extent unsatisfactory if the latter condition obtains.

In the most extensive fissures, if the edges are pared before the parts are disturbed, the operator is enabled to appreciate how far he may have succeeded in sufficiently exposing the edges; the bleeding is but trifling, and, as soon as it ceases, the cut surfaces can be cleansed with a sponge, and careful examination made in order to ascertain if more or less of the mucous edge should be removed. If the edges be not pared until after the soft tissues have been separated from the bone, it is much more difficult to ascertain whether sufficient mucous surface has been removed to ensure two perfectly raw edges being brought together; a very small patch of mucous membrane intervening between the edges of the flaps will, to the extent of its surface, or perhaps even to a greater extent, interfere with union of the most accurately adapted edges of a fissure by sutures.

When a cleft extends forwards through the whole of the velum, or even to a slight extent into the palate-bones, the operation is rather more complicated than that above described; and, though not beset with difficulties, requires a careful examination into the anatomy of the soft palate, and some little familiarity with the operation, before the surgeon can be confident of obtaining that success which should usually follow attempts to close a cleft palate by surgical interference.

If a fissure of the soft palate be carefully examined, and with the mouth open the patient make an attempt to swallow, the action of the muscles of the pharynx and tongue is such that the edges of the fissures are approximated by the action of the superior constrictors; the extremities of the bifid uvula touch, and often the gap is for an instant closed to one-third or one-half of its extent; but immediately afterwards the sections of the soft palate are drawn back to the walls of the fauces; and often the whole of the soft palate itself is so closely contracted into the side of the fauces, that a superficial observer might conclude, in some instances, that no soft palate existed. This latter effect is the result of the combined actions of the levator and tensor palati muscles contracting towards their attached extremities, and thus drawing up the sections of the velum. So that every attempt to bring the edges of the fissure together would be opposed by these muscles on either side pulling away from the median line, and consequently drawing directly from the line at which the edges of the fissure should meet to ensure union.

That the edges of a wound should meet without any traction on its margin by sutures is a fundamental rule which applies generally to all plastic operations; but especially is it absolute in any operation to close a fissure of the palate, whether in the hard or soft portion.

Union by first intention is equally essential to the success of an operation. If the approximated edges of the fissure do not unite at once after being brought together and there retained by sutures, the operation will fail for the time. No benefit or obliteration of the cleft will be gained by the process of healing by granulation. It is therefore most important that the condition of the patient should be that of perfect health. Nor can a surgeon be too careful in satisfying himself on this point before he decides the day for the operation. A loaded tongue, a catarrh, or a pustule on the skin—if any one of these be present it indicates, as a rule, a condition sure to spoil the best effects of the most skilful operator. In fact, conditions trivial in themselves, and perhaps of but little import in the balance which would influence other operations, should, in cases of cleft palate, be decisive against operative interference until a clean bill of health can be written for the patient.

The particulars of the following case illustrate the importance of such precautions. The author operated for fissure of the soft palate in a girl ten years of age, and apparently in perfect health. The operation was most satisfactory in its immediate results; the gap being entirely closed. The parts looked perfectly united on the second day. On the third day the little patient showed symptoms of scarlet fever, and in a few days after the line of union had entirely given way. The parents had brought this child from the country a few days previous to the operation, but had left another at

home recovering from the effects of scarlet fever, and of these circumstances not a word was mentioned until after the appearance of the eruption subsequent to the operation.

In an operation requisite to close the soft palate, the division of its muscles is, in one way or another, absolutely necessary, to allow, 1st, the edges of the cleft to be brought easily together, 2nd, to enable them to be kept in apposition without any strain on the sutures. This latter condition is essential to secure union and secure success.

The late Sir W. Fergusson was the first to propose and practise this division of the muscles of the soft palate before attempting to bring together the pared edges of a cleft.[1] Prior to the adoption of this method of operating, attempts to close a cleft in the soft palate had been attended by little, if any, success; and but very few surgeons ventured to undertake this operation. The action of the undivided muscles of the soft palate frustrated the most skilful attempts to overcome this deformity. The author may state that, when he commenced to deal with this class of cases, he had never seen such an operation as an attempt to close the cleft undertaken in St. George's Hospital. Very great credit is therefore due to Fergusson for having seized on the causes of difficulty and obstruction which rendered futile all previous attempts to remedy the deformity of a fissured palate, and for establishing the simple rule by which it could be successfully and effectually remedied. His work, indeed, in this respect was not only the foundation of the success of this operation, but of the subsequent improvements which have gradually followed, and rendered this once formidable and often unsuccessful undertaking a matter as simple as it is generally satisfactory.

The name of William Fergusson must ever be associated with this first grand improvement in the operation of 'staphyloraphy'; he hit accurately the exact difficulty after careful observation and dissection, and applied the result of his investigations with dexterous skill and success to the realisation of a most valuable and practical result. The author considers it only a duty to speak thus of one who did much for the advancement of operative surgery, and whose kindly nature attached him to all who had the privilege of his friendship. Fergusson's method was to divide these muscles with a knife bent at a right angle. This shaped knife enabled him to cut on the posterior surface of each flap of the bifid palate, and so divide the muscles from behind. A more simple and equally satisfactory method of securing the division of these muscles was subsequently recommended and practised by the author. He found that the levator muscle could be readily divided by cutting through the soft palate at each side, and moreover that the lateral incisions requisite for this purpose assisted in lessening tension when the sutures had been secured.

In order thus to effect the division of the muscles alluded to, the point of the uvula should be caught in the long spring forceps usually employed in operations for cleft palate, and drawn gently forwards and somewhat to the opposite side. A thin, narrow, sharp-pointed knife fixed in a long handle is then to be introduced into the soft palate close to the hamular process, a little in front and to its inner side. This process can be distinctly felt in the substance of the soft palate, internal and very little posterior to the last molar tooth. Running the knife upwards and backwards and somewhat inwards, the point should at last be seen in the gap, having been passed through the entire thickness of the soft palate, and having cut, if not wholly, at any rate partially, through the tendon of the tensor palati; the blade of the knife should now lie above most of the fibres of the levator. If the handle of the knife be next raised, the point will become depressed, and if the blade be then drawn forward, while at the same time it is made to cut downwards, it will travel through a considerable section of a circle on the posterior surface of the palate, and ensure the division of the greater portion of the levator palati. As the knife-blade travels downwards, the tension of the palate gives way, and often the division of the muscle may be felt to be suddenly effected. Provided the muscles be sufficiently divided on each side, as soon as the knife is withdrawn it will be found that all movements of the palate have ceased—it

[1] *Med.-Chir. Trans.* 1845.

has become pendulous and flaccid. Should, however, any resistance or action of the muscles be still observed if touched or pulled by forceps, the knife should be again introduced and the fibres a little more freely divided in a downward direction.

So far we have only referred to the treatment of fissure confined to the soft palate, but implicating it in its entire extent. It will be frequently observed, however, in some of the latter cases that there is difficulty in drawing the edges of the fissure perfectly together at the anterior extremity—viz. where the soft joins the hard palate. Here the mucous surface of the bone, as well as the substance of the soft palate, is sometimes very thin, and perhaps the fissure extends forwards to implicate just in the slightest degree the posterior edge of the palate-bones.

Whenever this condition is met with, when any difficulty arises in satisfactorily approximating the edges at this part, it is best to separate the soft tissues of the hard palate from the bone. First, perhaps, it may be requisite to extend the lateral incision somewhat forwards; then the soft tissues must be separated by commencing at the lateral incision and working inwards towards the fissure, and until this edge is reached. This can be best done by a slightly curved steel instrument with a somewhat blunt-ended blade fixed to a handle, and known as the separator.

The soft tissues being liberated between the lateral incision and fissure, a pair of curved scissors should be introduced through the lateral opening, and the attachments of the soft palate to the posterior edge of the palate-bone between the incision and cleft entirely freed on each side.

The flaps being perfectly flaccid, and their edges having been previously carefully and sufficiently pared, the approximation and perfect adaptation of the latter to each other must now be completed by the introduction and security of sutures. Very fine silk or thread or horsehair, according to the fancy of the operator, is preferable to silver-wire sutures in cases in which the soft palate is concerned. For the introduction of the suture it is best to use a needle bent at a right angle about an inch from its pointed extremity, and fixed to a long handle. This shaped needle can be passed very readily from one through to the other flap, and made to penetrate the latter at any point desirable, and the suture carried right across from one flap to the other without any change or stop.

When about to pass the first suture the surgeon should steady the flap by securing the end of the uvula with the long forceps; then, with slight traction, he can render the flap somewhat tense, and thus more readily secure the passage of the needle.

The needle having been made to perforate both flaps, and its point being now clear in front, the loop of the suture is to be secured by forceps or hook, or caught up by an instrument used especially for this purpose, and which consists of a narrow blunt blade, notched sufficiently deeply at one edge near its end to enable it to catch the suture in the notch as the instrument is drawn over it. One end of the ligature being thus secured on one side, the needle is to be withdrawn from the flaps, carrying with it the other end of the suture. As soon as the needle itself has been disengaged from the latter the two ends should be loosely looped together, and then given over to the hand of an assistant to hold outside the mouth.

The requisite number of sutures having been introduced and similarly treated, the surgeon should commence to tie each separately, from below upwards—carefully, so as to adapt the edges evenly to each other, and not too tightly, that something be allowed for subsequent swelling of the soft tissues. If the sutures be tightly drawn, they will most certainly cut themselves out by producing ulceration of the part on which they press.

A slip knot, to bring the edges together, and a second knot over that, are sufficient to secure each suture, and maintain apposition until union is safe. The ends of the sutures should not be cut off very close to the knots, for if of hair they are apt to slip, or if of silk or thread, when thoroughly sodden with saliva the knots are almost certain to become loosened, or even to become untied in a very short time, and much too soon for safety.

Great care is requisite to free the edges sufficiently of their mucous covering; it is better to remove a little more than necessary than an insufficient quantity, for the

success of the operation is not interfered with in the former case, whereas the operation will most certainly fail to some extent in the latter condition.

Mr. T. Smith's method of operating is, first, to pare the edges of the fissure from below upwards, then to pass the sutures, and lastly, 'to draw up the palate with all the sutures in one hand, and with the palate on the stretch to divide, if necessary, the palato-pharyngeus, and subsequently the levator palati; if the palate will not come easily together, two lateral oblique cuts may be made, one on either side above the highest suture, separating the soft from the margin of the hard palate to a small extent.[1]

The operation for closing the hard palate has now to be considered; it must, however, be borne in mind that this the major involves the minor operation—*i.e.* that in dealing with fissures of the hard palate the closure of the soft palate must be included. The defect in the bone is never seen without complete fissure backwards, throughout the entire soft palate right to the tip of the uvula.

Complete fissure of the palate, or one extending to, or near, the alveolar ridge, may generally be closed without difficulty. Although Fergusson mastered the difficulties of closing fissure of the soft palate, the late Mr. Avery, surgeon of Charing Cross Hospital, was the first in this country to deal successfully with fissure of the hard palate. It was under his able teaching that the author gained his early experience, and was subsequently enabled to bring the subject to the notice of the profession, in a paper published in the 'Transactions of the Royal Medico-Chirurgical Society.'[2] Some years previous to his death, Fergusson proposed a method of closing the hard palate by cutting through, on each side, the fissured processes of the superior maxillary and palate-bones close to their junction with the alveolar processes, and then by bending these down, without disturbing the soft tissue attached to them, made their edges meet in the median line. This, of course, only applied to the fissure in the hard palate, the soft palate being closed in the manner already discussed. This operation was successfully adopted by him in some few cases; but it did not gain favour with surgeons familiar with operations on the palate. It was a severe operation, and rendered quite unnecessary by that now usually adopted of separating the soft tissues from the bone.

The operation of closing a cleft in the hard and soft palate may be undertaken without hesitation in children after two and a half to three years of age; and may without risk or difficulty be completed in one operation, either in children or adults.

The surgeon having satisfied himself that the patient to be operated on is in a thoroughly good condition of health, will be wise to secure the services of some one accustomed to the administration of chloroform or ether in similar cases. The administration of chloroform is apparently safer in children than in adults; it possesses one advantage over ether in this operation, inasmuch as it produces less salivation and frothing of saliva during its performance. Still it has to be used with caution; and some little experience on the part of the administrator will prove a vast comfort and assistance to the operator. The anæsthetic has to be administered at intervals. When the patient is fully under its influence the operation is commenced by the edges of the fissure being pared; then bleeding from the cut surfaces occasion some delay in the proceeding; the patient now partially recovers, and again the anæsthetic has to be administered. These interruptions, frequently repeated, are well managed by one thoroughly accustomed to its administration, and advantage taken of the right moment to apply it. Economy of time is the result, whereas a raw hand may greatly add to the surgeon's work, and would probably fail to keep the patient sufficiently at rest without some risk of endangering life.

If the patient be a child, it is best to have it placed on a rather high narrow table with head only slightly raised on a pillow. The arms had best be secured to the sides, and advantage will be gained if the legs are tied together and fixed by bandage or strapped to the table.

[1] *Trans. Med.-Chir. Soc.* vol. lii. p. 84.

[2] *Ibid.* vol. xxxix. p. 71.

The patient being sufficiently under the influence of an anæsthetic, the gag for keeping the jaws asunder has next to be adjusted, and the head to be held steady by a nurse or assistant during the operation. The edges of the cleft to their entire extent should first be pared. This can best be done with a fine, short-bladed, and thin double-edged knife on a long handle. The double-edged blade has a great advantage in this operation, as it enables the surgeon to cut either forwards or backwards without turning the knife, and this is economy of time—a matter of some importance, as the surgeon can only act while the condition of insensibility to pain lasts.

Lateral incisions have next to be made through the soft tissue of the hard palate, and are to be carried back a short distance, so as to enable the surgeon to cut through a portion of the soft palate. In complete fissure of bone and alveolus, the incisions should be close to, and parallel with, the alveolar ridge on each side, and should extend as far forwards as the canine tooth, and backwards a little beyond the last molar. The extent, however, of the lateral incision in less extensive cases must of course be somewhat regulated by the extent of the cleft in the hard palate. In young children it is best not to extend the incisions more than is absolutely requisite to enable the operator subsequently to separate the soft tissues from the bone. If recklessly prolonged, the tissue forming the flap may slough from want of nutrition, and such a result will surely spoil the operation and terminate in disappointment. The soft tissue which lies between the incisions and the cleft must next be separated from the bone by means of the instrument already referred to as the separator, and this separation should be commenced from without, and continued inwards until the free edge of the gap is reached throughout the whole extent of the hard palate on each side. This separation of the flaps from the bone can be readily and effectually accomplished, with little risk of bruising or cutting through them : a matter of great moment for the ultimate success of the operation, for should the flaps be much bruised or torn in the process of their separation from the bone, ulceration or sloughing is apt to supervene and materially interfere with the union requisite to the success of the operation.

The flap detached from the bone should consist of all the soft tissues covering the latter—mucous membrane, areolar tissue, and periosteum. If the soft tissues are separated from the bone in the manner recommended, on the dead body, it will be found difficult (and we conjecture equally difficult in the living subject) to peel off the thick mucous membrane without the subjacent periosteum. The operation which Professor Langenbeck proposed, and to which he gave the name of 'the operation by muco-periosteal flaps,' appears to be identical with that introduced by Mr. Avery.[1]

When the soft tissues have been effectually separated from the bone, the flaps should fall inwards and downwards and meet in the median line, without the slightest traction being requisite. If the edges do not readily touch, the flaps have not been sufficiently detached from the bone on one side or the other; and care must be taken to ascertain the point which prevents their sufficient descent, and this should be freely liberated; nothing must be allowed to interfere with the free approximation of the edges.

The surgeon will find it an advantage to liberate behind the flaps any attachment of the soft tissues to the posterior borders of the palate-bones. This is best done by introducing a pair of curved scissors through the lateral incisions, and cutting inwards behind the flaps until the edge of the cleft is reached. What is divided by this latter proceeding is the attachment of the upper or posterior surface of mucous membrane and tissues of the soft palate. The latter is thus fully liberated, and offers no resistance by contraction or movement to the approximation of its edges.

Mr. Annandale[2] reports that he succeeded in closing fissures of the hard and soft

[1] See Prof. Langenbeck's treatise entitled *Weitere Erfahrungen im Gebiete der Uranoplastik mittelst Ablösung des mucös-periostalen Gaumenüberzuges.* Berlin, 1863.

[2] *Edin. Med. Journ.* 1865, vol. x. p. 621.

palate by the adoption of lateral incisions merely, without division of the muscles of the velum either in the manner adopted by the author or that which had long been recommended and practised by Fergusson; but Mr. Annandale carried the lateral incisions as far back as the last molar tooth. The results were perfectly satisfactory in the two cases related by him.

When the fissure is extensive, and more or less complete, the free separation of the soft tissues from the bone is amply sufficient to allow the margins of the flap to meet easily in the median line; occasionally they will overlap, in which case the edges require to be carefully adjusted. They should be examined, and, if found to be a little ragged, they should be made even; the possibility of any mucous surface becoming insinuated between them will thus be avoided, and the contact of two entire and fresh raw surfaces ensured. Fine silver sutures are generally recommended, and used to secure the edges of the soft tissues of the hard palate.

Mr. Annandale used silver wire with perfect success for closure of both hard and soft palate; but we think, as a rule, it will be found most convenient to use thread or horsehair sutures, with the needle bent at a right angle for the soft palate; while, on the other hand, it will be found most easy to pass a silver wire suture in a bent tubular needle through the soft tissues of the hard palate; and this in consequence of the arch of the latter being an impediment to the passage of any needle bent at a right angle. The latter can only be conveniently used for passing the more flexible sutures of silk, thread, or hair, while the curved tubular needle can alone be used with a metal suture.

A tubular needle, especially constructed for this purpose (introduced, we believe, by Mr. T. Smith), is the one we recommend. It is sufficiently curved to enable the surgeon to pass it readily through the flap to his right, across the fissure, and then from behind to penetrate the flap to his left until he can see the point of the needle projecting fairly in front of the mucous membrane of the latter. A long handle is attached to the needle, and has a small wheel and reel attached to it. On the latter is coiled silver wire, the free end of which is carried up and through the tube in the needle to near its point. When the wheel is rotated by the action of a finger or thumb, the wire is drawn on and pushed upwards as it uncoils from the reel until sufficient is apparent projecting from the point of the needle to enable the surgeon to seize it with a pair of forceps, and draw it out as far as may be necessary to allow of its being held with the fingers of the operator. This being accomplished the needle is to be withdrawn, leaving a suture lying across the cleft and through each flap. The wire is now to be cut off near the point of the needle, after allowing such length to the ends of the suture that they may easily be held outside the mouth; the points are then to be lightly twisted together and given over to the care of an assistant. As soon as a sufficient number of sutures have been passed, each should be separately secured by its respective ends being twisted together. A very effective little instrument may be used for this purpose, and with it the suture can be tightened up to whatever extent the operator may consider desirable. When sufficiently tightened, the ends of each suture should be cut off near the twist. With silver-wire sutures there need be no fear that the knot or twist will give way, provided it be properly and sufficiently secured; whereas the presence of a long end of a sharp wire in the mouth may prove a source of annoyance and trouble, especially in the case of a young child.

The use of silver wire for securing the apposition of the edges of the flaps of the hard palate has the advantage that it may be retained as long as the surgeon should consider desirable without producing local irritation or mischief. The removal of the suture must of course depend on the condition of union. As a rule the author is an advocate for their early removal, if justified by the appearance of the line of union. In children it is best to remove them under the influence of chloroform.

When a fissure of the hard palate is complete, or nearly so, the sides of it will be found to approach more or less to the perpendicular in their direction, as shown in figs. 125, 126. The result is, fortunately, that when the soft tissues are sufficiently detached from the bone, the flaps fall inwards and downwards, and readily meet in

the median line; there is always ample material to permit of their arching over the defective roof when they are once liberated from the bone.

But when the fissure in the bone is confined to the posterior half, the portion of the palate in front of the fissure, and whatever portions of the palate processes exist at the sides, will be observed to approach, in curve, the arch of a perfect palate as

FIG. 125.—Drawing from a model of a complete Cleft of the Palate. (St. George's Hospital Museum.)

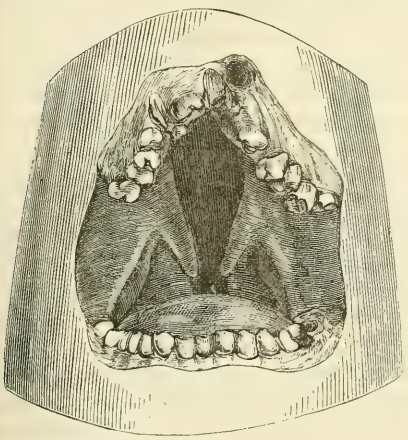
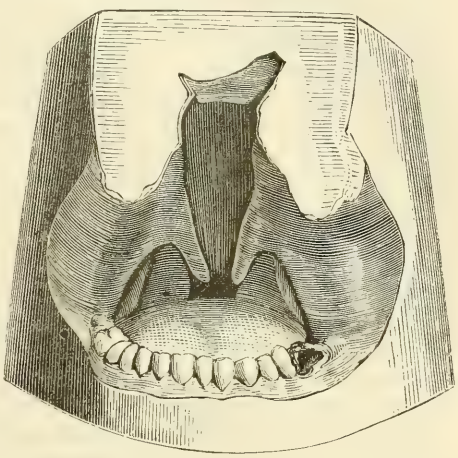


FIG. 126.—The same model cut in two to show the perpendicular direction of the sides of the gap.



seen in figs. 127, 128, taken from the model of a cleft of this kind; the bony fissure will often be broad, and rounded in front; and the membrane covering the bones very thin. In such cases, if the soft tissues are merely detached from the bone at the sides and front of the fissure, there is not much spare surface to close the gap; consequently the edges of the flaps do not meet in the median line so readily as

FIG. 127.—Drawing from a model of a partial Fissure of the Palate. (St. George's Hospital Museum.)

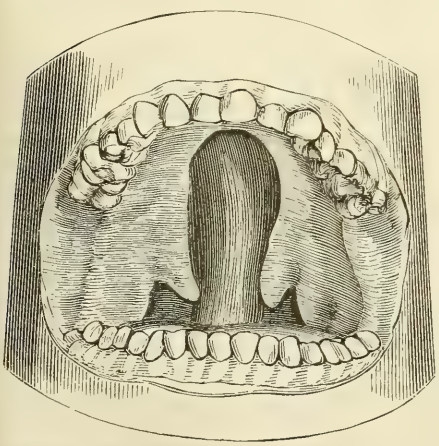
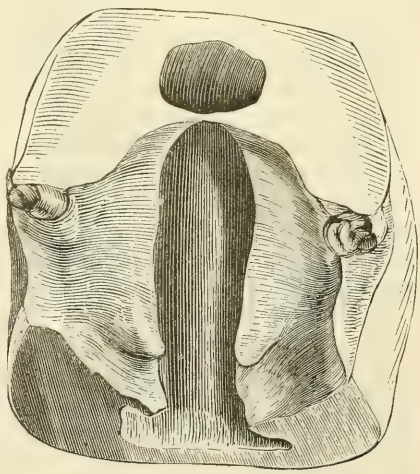


FIG. 128.—The same model divided, showing the much more horizontal direction of the sides of the gap.



occurs when the tissues are detached from the more upright sides of more complete fissures. Often, however, a fissure of the posterior half is narrow, pointed in front, and its sides covered with thick velvety mucous membrane. Under such circumstances little difficulty is experienced in getting the edges together.

When cases with broad fissures of the posterior half of the hard palate are operated on, it is almost impossible to approximate the entire length of the edges. The lateral incision may be free, and the separation of the soft tissues from the bone perfect, but still without *pulling* the edges together by sutures we cannot secure their meeting. But as sure as any force or pressure is requisite to *draw* these edges together, so sure is the suture to cut its way through a part, if not the whole, of the flap, and union does not follow. *Sutures should hold, not draw, parts together, if union is to follow.* Sometimes it will be found desirable to plug the incisions with a little soft cotton; this helps to push the flaps towards the median line, and takes off some of the traction of the sutures. This traction had better be avoided and the suture corresponding to this part only slightly drawn, so as to support the flaps rather than pull them together.

Such cases as the latter are most unsatisfactory to deal with. A subsequent operation may be attempted, and even repeated, if considered likely to be beneficial; but if the gap left should appear too large to be benefited by any subsequent operative interference, it would be better that the patient should use an artificial palate—at any rate, until the full benefit of the first operation can be estimated.

It not unfrequently happens that, under the most favourable circumstances, and with the greatest care on the part of the operator, a small aperture, or fissure enough to admit the flat end of a probe, will remain at the meeting-point of the hard and soft palate. Under such circumstances a metal plate should be worn for a period, *over the opening*, to prevent the percolation of saliva and other fluids through it. Under such treatment it has a tendency to close. But if any substance, such as a plug, &c., be made to project continually *into the opening*, and thus press on its margins, it will invariably and gradually increase in diameter; in time the plug will become loosely held and useless, to be replaced by a larger one, and this will be followed by progressive increase in the size of the aperture.[1]

If it should happen that a patient, with hare-lip and cleft alveolus and palate, should not have had the lip operated on in childhood, it will in all probability be found that the cleft of the alveolus is considerable—sometimes sufficient to allow the point of the finger to be passed through it from nostril to mouth. Under such circumstances the first care should be to operate on the lip. Subsequent to the healing of the lip, the action of its muscles in a very short time will so have approximated the edges of the separated alveolar ridge as to make them touch; though, in consequence of the interposition of the mucous surfaces, the chink between them never appears to be obliterated unless the mucous membrane be removed.

Occasionally small orifices are met with in the palate, either congenital, or more frequently the result of some cachectic or syphilitic condition, terminating in necrosis and destruction of a portion of the bony palate. In either condition, some little difficulty will usually be encountered in attempts to close such orifices. In all instances lateral incisions are requisite; and a repetition of the operation may be necessary even more than once before entire closure be effected. But, under any circumstances, should the opening be not ultimately filled up, it will generally be greatly reduced; so that the patient will be enabled, with the aid of an artificial palate, to secure himself from the discomforts attendant on a perforation of the roof.

Orifices through the soft palate are usually, if not always, the result of ulcerative

[1] The author would not be doing justice to the memory of the late Mr. Avery, in omitting to mention that he was the first surgeon in this country to close entirely a complete cleft of the palate. Since then the operation has been frequently and successfully performed in England and on the Continent. To Dr. Warren, of Boston in North America, the profession is chiefly indebted for having advocated the closure of the hard palate by operation. In the *New England Medical and Surgical Journal*, and also in the *American Journal of Medical Sciences*, as early as the year 1843 (also in 1848), Dr. Warren gave the result of his operations on fissures of the hard as well as the soft palate. Although complete closure does not appear to have been effected in any of these cases by *one* operation (which Dr. Warren appears always to have had recourse to, to close both hard and soft palate), yet his success by subsequent treatment in the management of these cases marks him as one of the pioneers in the advancement of this department of surgery.

action. Generally they close after a time, without the assistance of an operation. An opening, the result of strumous ulceration of the soft palate, and of the size of a six-penny-piece, in a patient under the care of the author, contracted and closed entirely, after cicatrisation of its margins had occurred, without operation or any surgical treatment. When, however, such an opening ceases to contract, and holds out no prospect of natural obliteration, but promises to be permanently patulous, its edges should be pared, lateral incisions made, and the margins brought together and retained in apposition by sutures.

The amount of blood lost during the performance of an operation on the palate will vary to a very great extent in different cases; but usually much more is lost in the process of detaching the tissues from the bone, than in the operation on the soft palate. The anterior and posterior palatine vessels sometimes bleed profusely after division; so much so, that occasionally it is necessary to make pressure for a few moments or more, with the finger; especially on the anterior, which generally bleeds more profusely than the posterior vessels. Iced or cold water should be used frequently, to syringe the mouth during the operation, when hæmorrhage is free. The loss of blood in no one operation, under the experience of the author, has been attended by evil consequences. Women are often apt to faint from a small loss of blood, but as the operation should be performed under the influence of an anæsthetic, such a result is less liable to occur than when pain is added to a loss of blood.

The patient should be *plentifully supplied with nutritious fluid and soft food* for some days after the operation: strong beef-tea, bread and milk, tea with half milk or cream, strong soup, and beer or wine, according to the age of the patient. In children milk with bread thoroughly softened and pulped in it is sufficient for many days, or, better still, milk alone. From the first hour after the operation, strict attention to this rule forms an important element in the satisfactory union of the flaps.

It might be supposed by some, who have not experience in this class of cases, that, after an operation on the soft palate, the effort of swallowing would be an effective impediment to union, in consequence of the action of the muscles of the palate; but it must be borne in mind, in the first place, that, prior to an operation, the palate-muscles have no power in themselves to assist in the act of deglutition. In the second place, the divided, and to an extent crippled, muscles of the palate are naturally passive in deglutition until union and reparation are established and complete. So, in practice, it is found that, as long as a patient is restricted to soft or fluid articles of nutriment, union is not retarded by the mechanical action of deglutition, however often he may be fed in the day. But if all diet be withheld, the patient's strength, already lessened by loss of blood, becomes lowered to such an extent that reparation is rendered doubtful, and union of the parts is retarded, if not ultimately prevented. All solid food should be avoided for a week or ten days.

The sutures should not be permitted to remain in the flaps many days. Usually, in the soft palate, the two lower ones should be removed on the second day; and if there be four sutures, one of the two latter should be taken away each succeeding day: that which is highest to be last removed. It has been supposed desirable to retain the sutures in the flaps for a longer period; but in each fresh case that comes under our notice, it becomes more evident, that if union is satisfactorily established, the retention of the sutures beyond the third or fourth day only tends to render it less effective: and if the condition of the edges of the approximated flaps is not satisfactory, and their union is not firm, the presence of the sutures will aggravate rather than diminish the evil. These observations do not apply to silver sutures; such sutures may be retained indefinitely without prejudice or irritation to the parts involved.

The patient should not be allowed to speak until union is complete, and the sutures are removed. He should be provided with materials for writing all his wants; a small slate and pencil will be found most convenient for such a purpose. In the case of a child, it is well that the nurse should endeavour to impress on it the necessity of silence, and use every possible means to amuse it. We have found nurses succeed in teaching this lesson, even a day or two prior to an

operation. It is not requisite to confine the patient to bed after the operation; but in some instances individuals prefer to lie still for a few days, especially if they feel weak from the loss of blood. The state of the tongue, before or after the operation, must not be taken alone as indicative of the patient's condition. All persons afflicted with cleft palate are liable to a dry, rough, and often coated tongue—the result of the constant passage of air in respiration over the surface opposed to the fissure. The injury, from the operation, to the soft tissues of the roof generally sets up a slight degree of feverish excitement, with a very coated tongue for a few days. This condition of tongue must not be taken to indicate the want of purgative medicine. In an instance under the author's notice, this state of the tongue was mistaken by a junior for a symptom of some great general disturbance of system, and to remove it, two consecutive doses of calomel were administered within four days: the patient became salivated, and the wound, which had been most satisfactorily united, gave way entirely a week after the operation.

A practical hint may here be useful with respect to use of sponges during any operation for the closure of cleft palate. Many small sponges fastened to short sticks, or fixed in short forceps, should be provided to mop out blood and saliva from the mouth. It will save time and trouble if these sponges are squeezed in a dry towel by the attendant nurse, as soon as each has been used by the surgeon or his assistant. It is then at once ready for use again; but if washed first in water and then dried on the towel much unnecessary time is lost, and no better result effected.

It may be asked what amount of improvement in articulation and speech is effected by the operation, in patients who successfully undergo it. Dr. Warren states: 'There is generally more facility of speech, which, so far as it has been in my power to watch patients at a distance, is constantly improving. A young man was present at a meeting of the Boston Society for Medical Improvement, about two years after the operation, and it was difficult to discover the least imperfection in his speech, although it had previously excluded him from society.' [1]

The author has found that in many cases the improvement has been most marked and satisfactory; and, in almost all, sufficient to render what was formerly unintelligible now readily comprehended: in one case, a stranger could not have detected a defect in articulation, on the delivery of a long sentence, three years after the closure of the entire palate. In all cases time is requisite, and much pains must be taken by the individual to acquire the power to articulate clearly such letters and words as, without a roof to the mouth, the tongue cannot command. It becomes, in fact, a task to the patient to learn how to pronounce correctly and distinctly a new dialect. The condition of the upper incisors is often very defective in cases of complete cleft, and when the cleft has extended through the alveolar ridge. Such cases should be placed in the hands of an experienced dentist, when the work of the surgeon is finished; for this irregularity of the teeth will often form a complete impediment to the improvement in articulation, although the palate may be most satisfactorily closed. The substitution of artificial teeth in front, in place of the defective ones often seen in these cases, is not only of considerable assistance towards improving the power to articulate more distinctly, but also materially lessens what may become a very conspicuous deformity.

It would be invidious to the task the author has undertaken, in writing this article, as well as deficient in respect to those who have devoted attention to the subject it refers to, were he, in conclusion, not to mention the names of Roux, Cloquet, Mettauer, Mütter, Pancoast, and Dieffenbach, with those of Warren, Avery, Fergusson, Annandale, and Thomas Smith. Each has so far aided in turn to improve this once apparently difficult and almost hopeless operation, that it can now be confidently looked upon as certain to effect closure of the most extensive cleft, and almost certain to improve thereby the most defective articulation.

[1] *Amer. Journ. of Med. Sc.*, April 1848.

Diseases of the Lips.

The congenital defects of the lips and mouth, and the treatment applicable to each, are described elsewhere in this work; as also the diseases of the tongue, and their treatment. In the following section will be described the diseases of the lips, jaws, and floor of the mouth.

The diseases of the lips are usually so marked, that they greatly affect the appearance of the individual; and they are often so serious, that they demand the most careful attention of the surgeon.

Simple '*cracked lip*,' when superficial, may be the result of long-continued cold weather, acting upon a constitution somewhat out of order. The crack is usually near to or at the middle of the lip; is not deeper than through the mucous covering; is often excessively painful when stretched, and readily bleeds if its edges be accidentally and suddenly separated. It may generally be relieved by slight attention to constitutional measures; an alterative, with aperients, if requisite, or such other remedies as the condition of the patient may indicate. The application of caustic will often relieve the pain at once; and some simple salve constantly applied keeps the surface soft and supple, and prevents its edges from getting dry and tender.

Should such a slight but painful crack be neglected in early life, and no measures taken to relieve the patient of this troublesome recurring sore, it will often happen that the crack deepens, and becomes more permanent in character: it becomes located in the part; and appears sometimes so deep, that it might be supposed that the middle line of the lip had been grooved out by ulceration; a very unsightly furrow, occasionally of considerable depth, is thus formed, to the great deterioration of the personal appearance of the individual. Under such circumstances, the relief, which in former years would have been readily obtained, is now no longer so available; for though the ulcerated base of the furrow may heal under judicious treatment, it will leave a chink or gap in the middle of the lip; and nothing short of paring its edges will remedy it. Under these circumstances, an operation may be recommended and undertaken, should the patient be in any degree desirous to have the disfigurement removed. The edges when pared should be brought together with one or two fine sutures.

Slight superficial fissures, indicated by their white lines, are occasionally to be observed on the upper and lower lips, in children as well as in adults: presenting an appearance as if at some former period slight ulceration had existed, though now healed and sound. If the teeth in the child be examined, they will be usually found to mark the characteristics of congenital syphilis; and occasionally other symptoms of hereditary taint will present themselves, or may be detected as having existed. These marked fissures of the lips have been constantly observed to be associated with an inherited stain.

Cracks of a severe character are generally observed in the under lip; but fissures are not at all uncommon in the upper one. These usually occur in children, and are mostly associated with, if not always indicative of, a scrofulous constitution; enlarged cervical lymphatic glands are constantly present in such children. Such a condition of lip is often obstinately persistent, and can only be combated by such measures as are advisable for the improvement of the general health. If very painful, an occasional application of a strong solution of nitrate of silver will relieve the extreme sensibility, for this will be sometimes very distressing in the movements of the lips; indeed so much so occasionally, that it interferes with the ready and comfortable use of the lip in conversation or during eating.

Fissures or ulcers of the commissures of the lips, or of their inner surfaces, should be very carefully looked to. In children they are usually transient, innocent, and associated with some passing constitutional disturbance; or more obstinate, and grafted on a strumous habit. In adults, or after the period of childhood, such ulcerations or cracks about the commissures must be regarded with extreme care and some suspicion, under apparently the most innocent and unsuspicious circumstances:

as a rule, they are the results of former syphilitic taint, and form one of the numerous varieties of secondary syphilitic affections; other indications, confirmatory of such contamination, will seldom be found wanting; and the condition of the part will be subservient to the treatment adopted for the general condition of the patient.

A troublesome, and often a recurring evil, which the practitioner has to combat, is the tendency, in some persons, of inflammation of the mucous membrane of the mouth to run into aphthous ulcers. Such ulcers sometimes become deep, and take some days before they assume any tendency to heal. They occur on the side of the tongue, the lips, and frequently on the frænum of the tongue. They are always painful, sometimes exquisitely so; and their extreme tenderness may last many days, though the ulcer itself be not more than the flat surface of a split pea. The ulcer is generally ashy on its surface, as if covered with a superficial slough of mucous membrane; the surrounding membrane is red, and slightly swollen.

These ulcers, whether aphthous or more extensive, are generally attendant on some constitutional disturbance. In some individuals they constantly recur; and in such persons, either some peculiar defect in health, or, perhaps, some local climatic or other influences, may be their exciting cause. The pain of the ulcer can be at once relieved by touching the surface gently with a point of nitrate of silver. It is as satisfactory as it is unaccountable, to observe how immediately the application of this caustic removes the often exquisite pain—pain which may render the patient almost unable to eat or talk. The ulcer usually ceases to be felt after the caustic is once applied, and heals without further trouble; a second application is rarely requisite.

The constitutional measures must be guided by the circumstances of the case, as the recurring form of ulcer is usually associated with a delicate state of health. Every attention must be given to the improvement and invigoration of the system. But medicine will frequently fail to produce that which change of air, soil, scene, and circumstances effect in a short time, and as frequently in an unexpected manner.

A very painful, not unfrequently a very troublesome, and sometimes a serious character of ulceration is observed to attack the mucous membrane of the mouth in children—especially those of the lower classes. It may occur in several smaller patches in different parts of the mouth, or in a larger single patch implicating a great portion of the inner surface of the cheek. Usually, at first it appears wholly confined to the mucous surface; occasionally, if not checked, it will run deeper, and implicate and destroy a considerable surface of the mucous and subjacent tissues. It commences in the mucous membrane, first, as if a slough had attacked it; then superficial ulceration follows, and this may extend in surface, as well as in depth; and if not arrested, may destroy so much of the soft tissues, that when reparation and healing are established, the resulting cicatrix will form an effective bar to the free movements of the lower jaw, and thus occasion more or less difficulty in the introduction of solid food into the mouth.

This condition of ulcer is always one of excessive pain; all movements of tongue or mouth, or contact of food, greatly aggravate it; and these circumstances, added to the febrile disturbance, or constitutional state of the patient, interfere materially with the child taking an amount of nourishment necessary to combat the evil effects of the malady.

As regards treatment, the administration of various tonics is usually recommended, and locally the application of numerous washes—chlorate of potash given internally, or used as a gargle, is highly commended. But after watching such treatment in many cases, too often with very unsatisfactory results, the author had recourse to the use of opium with very marked, and even rapid relief. In children, the use of opium must necessarily be very guarded, and it should only be given in very small doses. It is best to commence with one or two drops of laudanum every four or five hours, according to its effect. The dose should be repeated as required, provided the child be not drowsy, but withheld until drowsiness has disappeared.

The opiate appears to act beneficially, by first relieving the pain the child suffers in the attempt to take food, and this relief is most marked soon after the administration of the medicine. Whether it is this alone, or whether opium here, as in other conditions of ulceration and sloughing, acts specifically, we do not undertake to explain. If it alone enables the child to take nourishment, it carries with its administration a great boon. The child, relieved of pain, commences to take food without discomfort, and soon begins to improve in condition : the swelling about the mouth subsides, the sores put on a healthy action, and cicatrisation follows in a most satisfactory manner. In two cases, lately under the writer's care, no other drug was had recourse to during the stage of ulceration; food was the only tonic given, and local applications had no place in the treatment. The relief at once was most marked, improvement rapid, and convalescence most satisfactory.

Cancrum oris is treated of in the essay on 'Gangrene,' vol. i., p. 142.

It is apt to occur in children of the ill-fed and poorer classes; not unfrequently the attendant of a severe attack of scarlet or other low form of fever.

Sir Joseph Fayrer informs the author that this same condition of sloughing of the lips and cheeks is observed frequently in adults in India. the subject of splenic enlargement, and is frequently seen to produce frightful disfigurement and contraction of the mouth, when the patient recovers from the immediate sloughing. In this country the disease appears to be confined to childhood.

Vascular growths of the lips, &c.—The tissues of the lips and cheeks are favourite localities for the commencement of nævi, or vascular growths, whether of arterial or venous constituents. Such masses are unsightly at best, and are usually brought to the notice of the surgeon at an early period for treatment. The nature of the treatment is necessarily various; and the variety in treatment is dependent in a measure on the amount of the diseased structure. The nævus may be but a small red superficial patchwork of vessels; or it may be a large soft spongy cluster of veins, spreading over a very large section of one side of the face. The small arterial bright vascular patches are most common; though often a very large spongy venous nævus on the cheek may be observed in very early life.

When a small arterial nævus occurs on the margin of the inner surface of either lip, and is entirely superficial, it may be disposed of in several ways; but the application of the ligature is the most rapid, the most certain, and not more painful than any other. A needle passed through the base, and a fine ligature tied under the needle tightly round the mass, rapidly and surely effects its removal. In the course of a few days, the slough will have separated; and in a few more, the wound, which at first may appear formidable after the removal of the slough, quickly contracts and cicatrises.

If the diseased mass of vessels is larger, and dips into the substance of the lip, and has not spread laterally, but involves more in depth than in breadth, it may become a question whether it would be better to cut it out, as in an operation for cancer of the lip, or to destroy it by repeated introduction of ligatures through its substance, to be tied tightly, so that the mass be cut up into several pieces. If the mass involves the whole thickness of the lip and the corresponding surfaces of mucous membrane and skin, and, though extending towards the root of the lip, does not spread laterally, and can therefore be readily removed by incision, there are reasons for such treatment being preferred. The disease is at once got rid of; the relief is effectual; the operation is simple; the recovery is quick; and the scar left after union is but slight. The only precaution requisite in the performance of such an operation is to take care that the incisions are made through healthy tissue, and beyond the diseased vessels. The margins of the wound are to be brought together, as in the operation for hare-lip.

But rather than sacrifice skin or mucous membrane, if either or both are much implicated, it is far preferable to have recourse to ligature; if the disease spreads laterally, or extends in any degree into the cheek, ligature alone must be used.

When ligatures are applied to such nævi of the lips and cheeks, it should always

be borne in mind that scar must be avoided as much as possible, and mucous membrane saved as much as can be. The one is an eye-sore; the loss of the other is apt to produce distortion of mouth and a contracted cavity. Therefore, in using a ligature for nævus of the face, it is best to pass the thread entirely subcutaneously, and to tie it at the common point, where it was made to enter and emerge from the skin, so that no portion of the latter be destroyed. One ligature may be sufficient in slight cases; but in others several may be requisite to completely obliterate and destroy the diseased structure. The object to be kept in view in introducing the ligatures, is to effect the entire division of the diseased mass of vessels in several directions—that, in fact, they be cut into several pieces; so that if, in the first instance, a ligature be introduced round a portion of the tumour, in the second operation, one should be passed across; that each ligature should act on a fresh part; that ultimately the original mass may be divided into so many portions as will insure the consolidation of all the diseased tissue.

If the ligature be introduced on a needle at one point, and carried partly round the mass subcutaneously, and brought out at some distant point—again introduced and carried in or through until it reach the original puncture, and the ligature then tightly tied at this opening—no skin need be destroyed or mucous membrane cut or damaged. Each ligature should be tied as tightly as possible. It will soon cut its way free. The ends of the ligature should not be left too short; otherwise they may become buried in the wound in the subsequent swelling of the parts, and probably would cause suppuration to a greater extent than desirable, or even occasion some difficulty or delay, from being retained in the wound. The more tight the ligature is tied, the more speedy will be its release from the tissues which it grasps.

Vaccination should only be tried in very small nævi; the introduction of caustics, setons, the injection of perchloride of iron, each have their advocates; but none of these secure more effectual obliteration of the nævus than the ligature: they often fail to do so as rapidly; they often set up more irritation than is requisite for the purpose in view; they sometimes cause the skin to slough; and they are more painful in adoption, inasmuch as, being slower in action, their application must generally be often repeated before a satisfactory result is insured. The galvanic cautery has often been employed by the author; but after a great number of experiments in the treatment of such cases, he is satisfied that subcutaneous ligature will invariably be found quickest in action, most effectual in result, less disfiguring as regards scar, and, so far, less painful than any other kind of treatment. This is the case whether a nævus of the lip be large or small; unless the case be more suitable for the knife.

These remarks apply to the general treatment of arterial nævi, but when the nævoid tissue is evidently of venous character, and not too large, it will be found best to dissect them out. A clean incision through the skin sufficiently long to allow of this dissection is followed by little disfigurement. If in the eyelid, the cicatrix is often lost in the folds of the skin; or if in the lips, the mass can generally be attacked from within by cutting through the mucous surface alone. The author has frequently removed such nævi from the forehead, nose, eyelids, and lips, leaving in the course of a year or two hardly a perceptible scar. In dissecting out such small nævi the only precaution is to avoid cutting into the nævoid tissue itself, but dissecting beyond or outside of it. There is generally but very slight bleeding, as healthy vessels are alone cut through, but should the nævoid structure be accidentally wounded, more free bleeding will occur, as diseased vessels do not contract in the manner healthy ones do when divided. If, however, troublesome bleeding does take place, the bleeding point, or mass, may be readily taken up by forceps, and a ligature passed through or around it, and the dissection proceeded with. We have never found much bleeding follow such an operation: more frequently the remark applies that less bleeding takes place than may be anticipated. It must not be forgotten that venous nævi occasionally become arrested in growth, or degenerate, and even disappear without any surgical interference.

Cancer of the lip may be said to be confined to the lower lip, so rare is it in the upper; it certainly occurs more frequently in the male than in the female, the proportion being relatively large in the stronger sex.

The characteristics of cancer affecting the lip deserve particular attention. As a rule, we may say it is found to consist of the epithelial variety.

'Epithelial cancer has its primary seat, with very rare exceptions, in, or just beneath, some portion of skin or mucous membrane. Its most frequent locality is the lower lip, at or near the junction of the skin and mucous membrane.' [1] Commencing sometimes as a small warty growth on the lip; sometimes as if the mucous membrane were excoriated, with the excoriation resting on an inflamed and thickened base; sometimes as a small, indolent tubercle: the condition which does not at first excite suspicion, by degrees is seen to alter and the growth to increase. The wart grows in breadth and thickness; the excoriation becomes deeper, and rougher on its surface; the tubercle peels and ulcerates, scabs and peels again; until, sooner or later, the persistence of the mass, or the heat and pain of the part, attracts the more serious attention of the patient, and he then seeks for relief.

It is unnecessary here to enter upon the question of the pathology of cancer, or of its cachexia; the subject is discussed in the essay on Tumours, Vol. I.

The diagnosis of cancer of the lip may at first sight appear simple enough; and yet a certain degree of caution must be observed, ere an opinion be definitely arrived at, as to the precise character of a hardened sore, or of a raised tubercle of the lower lip. It has occurred to the author, and no doubt to many others, to point out, that a previously supposed cancer of the lip was but a chancre: a chancre of the lip has been mistaken for the more serious malignant sore. The surface under both conditions may be superficially excoriated; the lip may be thickened at the part; the sore may rest on a hardened base; and there may be the additional suspicious circumstance of attendant enlarged glands in the submaxillary region. It must, however, be borne in mind, that cancer of the lip is somewhat slow in its progress; that the cervical glands do not usually indicate the more grave implication of the constitution at an early period: whereas in chancre the glandular enlargement would be apparent in six or eight weeks, at the latest, from the first appearance of the sore; and probably, if no specific treatment have been adopted, other evidences of secondary symptoms, such as eruption, sore-throat, &c., would be manifest within six weeks of the first infection. As a mistake in diagnosis between cancer and chancre of the lip may occasionally occur, a few remarks in passing, on that subject, will probably not be useless.

Cancer of the lip is a disease of advancing, if not of advanced life; but man is often depraved, and experience teaches us that age need not be taken as a bar to the occurrence of a chancre of the lip.

A gentleman, past the meridian of life, applied to the author with a condition of lip which had excited suspicions as to its cancerous character. The appearance of the sore itself was extremely deceptive; scattered and isolated glands, slightly enlarged, and hard, were to be felt in the submaxillary regions; and his position and circumstances in life rendered it most improbable that a chancre could have been contracted on such a part. This sore was found to be accompanied by a commencing faint lichenous eruption. The patient was put under a mild course of mercury, and rapidly recovered; the hardness at the base of the sore entirely disappeared.

The characteristics of the two affections may thus be summed up: chancre of the lip may occur at any period of life, and is as often seen on the upper as the lower lip. Youth is the most probable period of the infection; and, it may be said, is most frequently observed in women: it sooner or later forms a superficial sore, raised on a base of an almost cartilaginous consistence: the surface appears more like an excoriation than an ulcer; or the surface may have cicatrised and the hard base remain. The glands of the submaxillary spaces enlarge at an early period, some six or eight weeks after the sore commences; and though hard, small, and scattered usually, they sometimes attain a large size. In one instance which came under the

[1] Paget's *Surgical Pathology*, vol. ii. p. 419.

author's notice, the glands on the right side were very much enlarged, and on the inside of the right half of the lower lip was a large hard cicatrix, the original sore of which had entirely healed some weeks previously. Secondary symptoms will sooner or later appear, unless early treatment be adopted.

Cancer of the lip is generally a disease of advanced life, and usually affects the lower lip; is most frequent in men; its progress is not uniform, nor often rapid; it does not implicate the absorbent glands at so early a period as chancre; does never thoroughly heal up and cicatrise or lose its hard base like chancre. The disease is usually of the epithelial variety of cancer, and varies a good deal in its method of commencement, in its progress, its growth, and its appearance; while the characteristics of chancre are uniform in most persons. Cancer always contaminates the absorbents, if allowed to run its course unchecked; ultimately it destroys, locally, all tissues in contact with its surface; the whole lip may be affected; and large cancerous masses may exist, at the same time, from the symphysis to the clavicle; and death ultimately follows.

The treatment of cancer of the lip usually resolves itself into removal by knife, or destruction by caustic. In the opinion of the author, it should be entirely restricted to that of the knife; and the earlier such treatment is adopted, the better the prospect of prolonging life.

The surgeon having decided to remove a cancer of the lip with the knife, the patient should be seated in front with his head steadily supported by an assistant; or placed in the recumbent position if an anæsthetic be used. If the disease occupy but a small portion of the lip, the mass may be removed entirely by a V-shaped cut through the healthy structure. The lip may be transfixed with a thin straight knife, and then cut upwards on either side of the diseased tissue: an assistant should hold the flaps as they are liberated from the diseased part. The flaps are to be brought together with pins and the twisted suture, or by sutures alone; care being taken that the meeting line of mucous membrane and skin be accurately adjusted. One, two, or three pins may be requisite; some surgeons prefer sutures without pins; and silver sutures answer the purpose very satisfactorily. If pins be used, as soon as they are fixed by suture, the sharp-pointed ends should be cut off, and the remaining ends so protected that they be not readily caught by the dress, &c. of persons in attendance, otherwise the patient runs the risk of being accidentally much hurt, for want of a little foresight. In all these operations the pins or sutures should be removed at the end of forty-eight hours at the latest, and the wound supported by adhesive plaster.

If a large surface of the lip be affected, and the disease be superficial, it may be readily removed by a semicircular sweep of the knife, or a cut with a pair of curved scissors; in either case the opposed edges of skin and mucous membrane should be brought together with sutures. In the incisions through the lip, the labial arteries bleed freely. With the aid of the pins and twisted suture the hæmorrhage is readily and effectually checked; with the semicircular incision a ligature or two may be requisite.

It will save some little inconvenience, and also pain, to have the sutures well oiled before they are twisted round the protruding extremities of the pins: by using this precaution, it will be easy to remove the sutures subsequently; when not oiled, they adhere to the pins and to the skin, and always occasion pain on removal.

The use of caustics, in cases of epithelial or other cancers of the lip, is but waste of time, and an unnecessary infliction of suffering; provided the disease be not too far advanced for removal by the scalpel. The knife should always be used when practicable; caustic, only when the disease is too far advanced for removal by the knife. But even then it is doubtful whether any application of caustic, by retarding growth or destroying material, compensates for the pain, and often exquisite suffering, which is inflicted by its use. If caustic be decided on, the most efficient is the actual cautery used in the form of the benzoline cautery, or the chloride of zinc applied in the form of a paste.

The advantages of operating early can only be appreciated when compared with the

more rapid results of a case which is allowed to run its course unmolested. But under the most favourable circumstances, we can only expect the operation of removal to relieve for a time; the disease usually returns, and generally shows itself in the glands of the submaxillary region. These in time increase to a great size; the skin over them ulcerates and sloughs; an ulcerated and fungoid surface discharges profusely, and often bleeds largely; and life is thus drained away. We cannot here more fully discuss the advantages of the removal of cancerous affections of the lip; but as such affections are not ultimately amenable to any treatment, nor the disease ever eradicated by topical remedies, their entire removal offers the speediest prospect of present relief; and though such a measure should be adopted as soon as the disease is decided to be cancer, the remedy is at best but a choice of evils, and must not be held out as one of radical benefit.

Cases are, however, occasionally met with in which somewhat more satisfactory results follow removal. A gentleman had suffered for some few years from a troublesome superficial ulceration on the right side of the upper lip, and part of the right cheek above the affected portion of the lip. This had been kept in check, and had occasionally healed under the application of arsenical and other caustic preparations; attended, however, by much suffering whenever under such treatment. Though each application of caustic was followed by healing, each cicatrisation was succeeded by fresh ulceration. This condition continued till the right half of the upper lip became thickened to some extent, the ulceration was observed to be less amenable to treatment, and much constant burning pain was established in the part. The author was now consulted. The ulceration, although somewhat superficial, was supported on a thickened and hardened base. It implicated a patch of the right cheek, the size of half-a-crown piece, and slightly encroached on the adjacent ala of the nose at its lower border. The right half of the upper lip was much thickened, and in its substance could be felt some suspicious hard spots, or tubercles, which conveyed the impression to the touch of incipient epithelioma. The whole of the diseased mass was removed by the knife. One incision was carried from near the inner angle of the eyelids downwards, so as to include the ulcerated portion of the ala nasi, and then through the centre of the upper lip to its free border. A second incision was commenced at the point of the first above, and carried down to the angle of the mouth. The piece between these incisions was then dissected freely from its attachments. The divided lip was brought together by means of hair-lip pins and twisted threads, and the upper portion of the wound by silver wire sutures. The mouth was at first very much drawn to one side, and the nose also, but to a less extent. The entire wound healed quickly and most satisfactorily.

The examination of the diseased portion proved it to be true epithelioma. It is five years since the operation, and when seen this year (1882) the patient remained perfectly well; and there was but little disfigurement of the face.

Cysts of the lip are not infrequent. They are generally observed near the free border, or inner surface; usually of the lower lip. They sometimes increase to an inconvenient size. On the margin of the lip they seldom project beyond the mucous membrane; the skin is usually free. They are generally well raised from the surface; covered by very thin membrane; usually semi-transparent, but occasionally somewhat discoloured and of a venous hue, as if veins traversed or opened into a cavity.[1] They contain either viscid clear mucus, much like the contents of the cysts termed ranulæ; or sometimes a darkish fluid of thick consistence. They are generally single, though their surface and shape may be irregular. They seldom grow large; though this may be the result of locality, as the surgeon is usually required to remedy the evil before it occasions much inconvenience, or becomes unsightly.

Such cysts are usually innocent in their character; do not recur in the part when effectually treated; nor are they congenital, unless of that variety alluded to as

[1] 'Cysts formed of dilated portions of blood-vessels shut off from the main stream.'—Paget, *op. cit.* vol. ii. p. 27.

connected with blood-vessels. These cysts are often not larger than small peas, or from that to the size of a small walnut; painless; indifferent to being handled; and only inconvenient from size or disfigurement. They occasionally remain stationary for life; are then usually small in size, and frequently discoloured; the more transparent ones have the greatest tendency to increase, as if dependent on the secretion of a gland, which probably, having had its duct obstructed, has given rise to the formation of the cyst.

The treatment to be adopted in such cases is very simple and usually satisfactory. The cyst should be freely divided, and, when entirely emptied, it is best to wipe the interior with dry lint, then freely apply strong nitric acid to the whole surface of the lining membrane. Though the treatment be rather sharp for the moment, the pain soon subsides, and the patient will be able to eat and talk as usual. No surgeon should be satisfied with simply puncturing such cysts; a puncture, or even a small incision, will frequently close before the cyst is obliterated; and in a few days it becomes as large as it was originally. Even after the application of nitric acid, unless the opening be free, and care taken to keep it so, until the cyst be entirely destroyed, the accumulation of fluid is very apt to recur. It is a good precaution to touch the edges of the opening with nitric acid for a few days consecutively, to insure its not closing until suppuration be fully established, so that the lining membrane be obliterated. Occasionally a cyst in the lip is complicated with some solid growth. Such growths are usually somewhat of a glandular nature,[1] and very favourable for removal. These tumours are not common. They resemble, to some extent, the mammary glandular tumours in consistence and character; or 'they may appear intermediate between the foregoing and those tumours which are found over, or near, the parotid gland, and consist of mixed glandular and cartilaginous tissue.'[2]

Sir J. Paget refers to a case removed by himself from the upper lip of a man; and describes a second case, which occurred under Mr. Lloyd's care, in a man who had a tumour in his upper lip for twelve years, when it was removed. 'The tumour was firm, slightly lobed, yellowish-white, smooth. In general aspect it resembled the mixed tumours over the parotid; but its minute structure presented as perfect an imitation of lobulated or acinous gland-structure as any mammary gland.'[3]

The lips, more especially the upper one, will occasionally be abnormally prominent, thickened, and even somewhat everted in strumous children, or in children in whom symptoms of inherited syphilis are well marked. In the former condition, there is not much benefit to be derived from any specific treatment; but should the child grow up under favourable sanitary and other general domestic conditions, this disfigurement will probably materially diminish, even should it not entirely disappear. But thickened lips, due to syphilitic taint, are occasionally met with in adults, as well as in children. The author has had lately under his care a patient in whom both upper and lower lips became considerably hypertrophied. They were prominent, somewhat everted, slightly marked with superficial furrows, and conveyed the impression to the eye that the enlargement must be due to dropsical effusion. There was no corresponding œdema of the cheeks, nor any enlarged glands to be discovered in the submaxillary spaces. The patient complained that they felt hot and painful. He had long been the subject of syphilis—patches of white mucous membrane were well marked on the inside of cheeks and lips. His condition greatly improved under treatment, especially as regards the lower lip, which returned almost to its natural size. Another form of thickened lip will be found due to hypertrophy of submucous gland cells. 'On removing the hypertrophied mucous membrane, a number of small granular bodies, the size of hemp seeds, and made up of gland-cells, are always found underlying a healthy mucous membrane.'[4] This enlargement shows itself by a prominence or bulging rather of the mucous membrane on each side of the median line, rather like a fulness of the inner surfaces

[1] For a specimen, see Museum of St. George's Hospital; referred to also by Paget, *Surgical Pathology*, vol. ii. p. 73.

[2] Paget, vol. ii. p. 262.

[3] *Ibid.* p. 263.

[4] Bryant, *Practice of Surgery*, vol. i. p. 515.

of this portion of the lip than actual general thickening. This is dependent on the increase of size of the glands existing in these parts. Mr. Bryant states that when removed, by careful excision of the diseased submucous tissue, it does not recur.

Cysts of the mouth may be congenital, or the result of obstructed ducts, ranulæ, or possibly bursæ between the muscles of the tongue.

Congenital cysts of the mouth are not frequent, though they occur sufficiently often to be familiar enough to surgeons. Mr. Cæsar Hawkins long ago drew attention to their real character.[1] Usually such cysts are single, and may increase to a large size; or they may be multilocular and numerous, and occupy a considerable portion of the floor of the mouth. Whether single or compound, they will usually be found between the lower jaw and the tongue; if large, pressing the floor of the mouth forwards and upwards, and the submaxillary soft tissues outwards and downwards.

An infant three weeks old was sent to the author by Mr. Frank Buckland, then assistant-surgeon of the Second Life-Guards. The mother found that the child suckled with increasing difficulty during the last few days, in consequence of a swelling on both sides of the floor of the mouth, which was pushing up the tongue, and had much widened the lower jaw. It had also encroached backwards so as to press somewhat on the larynx and pharynx; respiration was somewhat impeded; deglutition was slow and difficult. Under the tongue and on both sides of the mouth there projected a lobulated irregular cystic mass; some portions of which, especially on the left side, were so prominent, that the tongue was pushed upwards by it, and the tumour bulged out between the tongue and the lower jaw, to such an extent, that the infant could not close its lips. An irregular lobulated swelling projected on each side of the throat, immediately below the lower jaw.

The cysts projecting between the tongue and lower jaw were thin and pellucid, the membrane covering them pale-coloured, and free of vessels on its surface.

A seton passed through a cyst on the left side soon allowed it to collapse; a thin purely transparent fluid oozed out through the punctures. On other days other threads were passed through some of the more prominent cysts, while some were punctured. The partial reduction of the sublingual swelling enabled the infant to partake more freely of food, and for some days a slight improvement was observed in his condition. This was but transient; evidently other and deeper cysts became larger; gradual increase of dysphagia and dyspnœa supervened; and the infant died, greatly emaciated, the sixth week after its first visit to the hospital.

On examination, it was found that this cystic formation involved all the tissues between the mucous membrane of the floor of the mouth and the skin covering the submaxillary region; so that not only did the mass of cysts (it might be termed a multilocular cystic tumour) project upwards in the mouth, but downwards on both sides, in the submaxillary spaces. On a section of the tongue, the whole muscular structure was seen studded with cysts; small and millet-like in some parts, rather larger in others; some single, others multilocular. The larger ones were generally multilocular, with bands running across and around their walls.[2]

Other forms or characters of cysts are occasionally observed in the mouth, sometimes between the gum and the cheek.

Sir J. Paget describes a case of this nature, which occurred in a woman, in whom a soft elastic swelling pushed out the thin mucous membrane of the upper jaw, producing externally an appearance somewhat similar, at first sight, to distension of the antrum. An incision into the cyst allowed the escape of nearly an ounce of turbid brownish fluid, containing crystals of cholesterine.

Cysts connected with defective development of teeth, 'dentigerous cysts,' usually confined to the alveolar regions of the maxillæ, are not uncommon. Their history and treatment are related by Mr. Salter, and will be found in the preceding essay.

Obstructions of mucous follicles occasionally give rise to the formation of mucous cysts, already spoken of; the obstruction of the submaxillary or sublingual ducts may be productive of the cysts termed 'ranulæ.'

A more rare, but well-known character of cyst is met with amongst the soft tissues of the submaxillary region, usually between the symphysis and angle of the lower jaw, and more or less deeply seated between the floor of the mouth and the inner surface of the bone. This cyst will be found to contain sebaceous matter, mixed not

[1] *Med.-Chir. Trans.* vol. xxii. p. 231.
[2] The preparation is in St. George's Hospital Museum.

unfrequently with hair or other evidences of its dermoid origin. The amount of its contents is sometimes considerable, due probably to the age of the cyst; for its very gradual distension has allowed it to attain a size larger than would otherwise be expected, and this without producing local inconvenience or trouble during the greater period of its existence. The contents are consequently often offensive, and semi-purulent when evacuated; the larger proportion will be, however, the result of epithelial accumulation.

Its existence may have been noticed from birth; but as far as experience enables us to arrive at a conclusion on this point, it appears more frequently to become evident at some later period of life; for, although in all likelihood congenital, it may originate in so small a cavity, and may so slowly fill, that it will only make itself conspicuous to sight or be detected by touch at some subsequent period.

The opinion arrived at that such cases are usually congenital, that their origin is due to imperfect closure of a branchial fissure, and that they are closely allied to such cysts of a dermoid character as are frequently met with in children, in the cheek or at the orbital edges, appears to be founded on very carefully sifted evidence. Many writers have drawn attention to this subject, but Mons. Jean Cusset[1] has more recently and in a very complete manner, in a memoir to which the reader is referred, described the abnormal conditions dependent on imperfect occlusion of branchial fissures, and the occasional consequent formation of such cysts.

The author was consulted by a gentleman with a large cyst below the angle of the jaw, and protruding forwards towards the median line: it projected much into the left side of the floor of the mouth, and the tongue was consequently pushed somewhat to the opposite side. Articulation was slightly interfered with, and some difficulty was experienced in mastication and deglutition. Some fifteen years previously this patient had been operated on by Sir W. Fergusson for what was described as a somewhat similar swelling. An attempt was made to dissect it out. A large portion of the cyst had evidently been removed, but most probably a small portion had been left behind. There was considerable bleeding at the time of the operation. About three years subsequently a swelling recommenced in the original seat of the tumour, and had gradually increased till seen by the author. The cyst was freely laid open from without, and about a pint of semi-fluid sebaceous matter was observed to escape, the forefinger introduced into the cyst detected a cavity, which, besides extending along a considerable portion of the floor of the mouth, ran backwards and upwards inside the ramus of the jaw, and apparently terminated just behind the tonsil and in close proximity to the pharynx, from which it was separated by a very thin septum. The cyst was freely washed out daily with a lotion (of 1 in 20) of carbolic acid until it had contracted and become perfectly closed. During the process of washing out, and especially at the earlier period of treatment, large and numerous flakes of epithelium would be daily removed, and this desquamation continued almost to the latest date. It is now four years since the last operation, and the patient has remained free from recurrence of any swelling.

A young woman was admitted into St. George's Hospital, with a considerable swelling on the right side of her mouth and neck. The swelling bulged into the mouth; had displaced the tongue to the opposite side; and protruded downwards in the submaxillary region. The swelling was painless, but inconvenient from its size; it had been many years forming, and it was doubtful whether it was not congenital. A free incision through the portion projecting into the mouth allowed the escape of a large quantity of a thickish yellow fluid, most offensive and putrid in smell, similar to the contents of a suppurating sebaceous cyst. By degrees the cavity contracted and closed.

This patient returned to the hospital about three years afterwards. The cyst had again filled, and projected a good deal below the lower jaw. It was now opened by the author, in the neck, below the lower maxillary bone, and a large quantity of offensive sebaceous-looking fluid was evacuated; a seton was then passed through the cyst, and retained several days, until the cavity had become perfectly contracted. The opening soon closed, and, as far as could be ascertained, the cyst appeared to have been obliterated. Nothing more has been heard of the patient.

The deep seated connections of these latter cysts render their removal by knife,

[1] *Etude sur l'Appareil Branchial, &c.* Masson, Paris, 1877.

if not nearly impossible, at any rate so hazardous, that any attempt to dissect them out had better be avoided, if free incision and daily washing out with some stimulating disinfectant offers a prospect, by destruction of their lining membrane, of their perfect contraction and so far eradication. A case, related by Fergusson, well illustrates the difficulties a surgeon may have to encounter in the attempt to remove the cyst by knife, to say nothing of the danger the patient may be placed in.[1]

The diagnosis of cysts of the mouth is not often complicated: usually, fluctuation is very evident; as, frequently, the surface of a portion of the cyst projects into and on one side of the mouth, so that it may be seen covered only by mucous membrane; the walls are thin and pellucid; the contents visibly transparent, or slightly tinged from some accidental circumstance or individual peculiarity.

In other cases these cysts present more obscure conditions; they may lie deep among the muscles of the floor; or may press backwards and interfere with the movements of the larynx or pharynx; or a sanguineous tumour may be mistaken for a cyst, though sanguineous tumours are exceedingly rare in these parts.

Such serous and mucous cysts as we have referred to may be treated without hesitation, and without much danger. If very large, it may be as well to draw off a portion of the fluid, in the first instance; and subsequently have recourse to setons, or injections of iodine. But as in any operation in the region of the mouth and neck œdema may occur about the root of the tongue and the fauces, and interfere with deglutition or respiration, it is better to select the less irritating and most simple treatment, before proceeding to the more heroic.

In the treatment of *mucous* cysts of the mouth, a seton, or injection of iodine, will often be found inefficient; the cyst may fill again in a short time. If a portion of the cyst be cut away, the contents allowed to escape, and nitric acid applied freely to the interior, the treatment will generally be found successful. Some of the small, isolated, mucous cysts, situated immediately under the mucous membrane, may be readily removed by the knife; but the attempt to remove a large and more deeply-seated cyst is hazardous and unnecessary.

By laying the cyst freely open, in all probability it will close up from the bottom, or, at any rate, become so much diminished that ultimately a seton, or injection of iodine, will effect its obliteration. A silver wire may be used as a seton, if the cyst contents, by tapping, are proved to be clear and thin; but if opaque, dark-coloured, thick, or purulent, a free incision is the safest, the most effectual, and the least tedious treatment.

A large cyst opened by incision in the mouth, and found to contain purulent fluid, may not contract very rapidly, in consequence of matter bagging downwards in the neck, in the lower part of the sac. Under such circumstances, a small opening may be made under the jaw, and a drainage-tube introduced. But as a scar in the neck, especially in women, is always objectionable, such an opening had better be avoided unless absolutely requisite.

By far the greater number of the different varieties of cystic formations (independent of bone) will be found on the inner surface of the lips, the surface of the gums, or on the floor of the mouth; and the treatment above described may be followed accordingly, care being taken to ascertain first the character of the fluid contained; for should the contents be blood, the treatment should be different to that described.

Sanguineous cysts about the mouth are rare. When present, they are usually seen on the lips, near their free border. Instead of free incision, when deeper seated they should be treated with setons or ligatures, when superficial and accessible, they may be dissected out, or included in a ligature, like a nævus.

To sum up the evidence on the history of mucous or serous cystic affections of the mouth, we find that, in early life, they occur either singly or in clusters; are generally of a congenital nature; and are found most commonly on the floor of the mouth, or, in after life, on the surface of the gums. Venous or sanguineous cysts are generally observed in the lips and on their inner surface; are usually congenital,

[1] *Practical Surgery*, p. 599. 3rd edit.

and frequently stationary; in this they differ from other cysts. Sebaceous cysts, containing sometimes a mixture of epithelial, thick, white, and often putrid matter; hair growing from the lining membrane (which partakes of the character of cuticle); or loose hairs; bone or teeth—these have no peculiar affection for locality, are most capricious in their selection of spots for habitation, and may be found in any part of the mouth or its immediate neighbourhood. They are usually round, small, and, if immediately under the mucous membrane, appear like a white marble embedded in the areolar tissue. Their inclination is to grow slowly; so slowly, as already stated, that years may elapse before their presence occasions inconvenience. These may all be considered of the congenital variety. Mucous cysts, ranulæ, cysts of the lips connected with portions of solid or glandular growth, some serous cysts, and those generally single, will be found to commence after birth, and at different ages. They usually occur before very advanced life.

Solid growths of the lips and mouth, of a non-malignant, *i.e.* non-cancerous character, are not of many kinds, nor do they frequently occur. Labial glandular tumours have already been referred to. Occasionally a fatty tumour grows among the muscles of the tongue, or about the floor of the mouth. The diagnosis is usually simple, though when deep-seated it may puzzle the surgeon, until he cuts down the growth. Its tendency is generally to protrude towards the skin rather than towards the mouth; the constant movements of the tongue being usually sufficient to direct the mass towards the least resistant surface.

A fatty tumour need only be removed when of an inconvenient size. A free incision over its surface, below the jaw, will generally allow of its being readily dissected or dragged out.

The author removed one for a lady, forty years of age, who had been aware for some years of its existence, under the tongue and jaw, on the left side. On cutting freely down upon it, the lobes of fat were found to dip deeply into the floor of the mouth, round the mylo-hyoid muscle; but the whole was readily removed.

The chief danger attendant on such an operation is extension of inflammation and suppuration to the intermuscular tissue about the root of the neck. The lady alluded to had for some days considerable pain and difficulty in swallowing, but ultimately recovered.

Occasionally a calculus will be found impacted near the orifice of a salivary duct, which possibly may give rise to some obstruction and consequent distension. But this is not often the case; the calculus may not be able to escape, but the secretion of the gland usually finds its way past the calculus. We have seen the presence of a calculus in a salivary duct give rise to suppuration around it. Occasionally, from neglect or indifference, one has been known to acquire a size which would be usually considered an intolerable nuisance—Mr. Bryant mentions an instance in which a salivary calculus weighed 48 grains[1]—and was a source of constant disturbance to the patient's comfort. It may be readily removed by a slight incision over it through the mucous membrane.

The condition, in infants, known as 'tongue-tie' is treated in the essay on Diseases of the Tongue.

The tumours which affect the maxillary bones will be found to consist of the (1) Cartilaginous; (2) Cystic; (3) Fibrous; (4) Myeloid; (5) Osseous; (6) Vascular; (7) Mucous, or Myxoma; (8) Cancerous.

It is not intended that the order in which they are placed should be taken as any indication of the relative frequency of these growths; it is simply intended to indicate all those which are found to attack these bones.

There are few points in practice which demand more careful consideration than the origin and outgrowth of these tumours. It is only by a most careful examination of each case that the surgeon can hope to arrive at a satisfactory diagnosis, or be enabled to decide with anything like confidence, whether recourse should be had to operative interference, or whether he should determine not to meddle unnecessarily

[1] Bryant, *Practice of Surgery*, vol. i. p. 518.

with a disease which offers no hope of benefit from treatment. In our observations with regard to the individual characteristics of these tumours we shall consider only their clinical aspect and general practical features; their more minute pathological characteristics and structure will be found fully described in the essay on TUMOURS, Vol. I.

Before entering into this examination, we think it desirable to refer to two other growths, not included in our list, but usually mentioned in most works on surgery in connection with diseases of the jaw. Either of these conditions might possibly be mistaken for some of those in our list, were not allusion made here to their occurrence as well as to their character. One is a growth from the gum; the other is an expansion of the alveolus, due to a diseased tooth-fang. Epulis is the name given to that from the gum. It will found fully described at p. 454. It is only here necessary to mention that the growth is generally owing to some irritation set up by a decayed tooth. It will be seen up from the gum, and often surrounding the tooth, is generally of a darkish or bright red colour, varies in size according to its duration, and often bleeds when examined. It not only grows from the gum, but often dips into, and is attached to, the lining membrane of the alveolus. The extraction of the offending tooth, and the removal of the growth by scoop, knife, or escharotic, is usually sufficient for its eradication. Should it, however, be found more intimately connected with periosteum or bone, or recur after removal, and subsequently prove troublesome, it will be probably found to partake of the myeloid character—a condition to be hereafter described.

Again, the base of the alveolar ridge may at any given point become so much expanded as to be mistaken for an osseous growth of the jaw. This expansion will be due simply to a peculiar diseased and enlarged condition of the tooth-fangs, known as an 'Odontome.'[1] It is relieved at once by the removal of the tooth, but is of sufficient importance to be mentioned here, although it may be said to fall more especially to the department of dental than to that of general surgery.

Cartilaginous tumours of the bones of the face are rare, and the upper and lower maxillæ may be said to be almost free from their attacks.

Paget alludes to but one well-known case, which occurred in the upper jaw of a patient in Guy's Hospital. Mr. Beaumont, Professor of Surgery in the University of Toronto, has recorded an interesting case in the 'Royal Med. and Chir. Transactions,'[2] which occurred in a boy seven years of age, affected the lower jaw, and was successfully removed.

In the Museum of the College of Surgeons is a wonderful specimen of one of these tumours, which implicates the greater portion of the lower jaw; it had been some eight years growing, and when the patient died, exhausted by its ravages, it measured two feet in circumference.[3]

The symptoms and prognosis of enchondroma are the same, when it affects either of the jaw-bones, as in other parts of the body. These tumours of the jaws may be removed with much confidence of relief. The operation cannot be too early decided on; delay may be so far dangerous that a very rapid growth, by a short postponement, may really make the operation very severe and extremely hazardous.

In the removal of the smallest cartilaginous tumour, care should be taken that every particle of the surface of the bone from which it is growing be freely removed. In the removal of the larger tumours, it will depend on the involvement of the bone how much of it has to be removed. The greater portion of one side, or even the whole, of the lower jaw, or the whole of the upper maxillary bone, if involved, must necessarily be taken away. The disease will probably be restricted to one side in the upper jaw; in the lower it may more readily involve the greater part of the bone. The prognosis after operation is usually favourable; but it should not be overlooked that enchondroma sometimes recurs, and that in other cases the tumour grows rapidly, and large cysts are developed in its substance. Both these forms of enchondroma are apt to approach in character to that of cancerous tumours.

[1] For description, see p. 461. [2] Vol. xxxiii. p. 243.
[3] Museum Catalogue, No. 1034.

Cystic tumours of the jaw are not very uncommon.[1] We undertake their consideration in this place, in order to mark particularly the distinction which must always, pathologically, be made between the secondary cysts of bone resulting from degeneration of cartilaginous tumours, and the primary cystic tumours which attack the upper and lower maxillæ. The latter are seen to originate in the substance or from the surfaces of the jaw, under a variety of unexplained circumstances.

Cysts of the jaws are sometimes found to be connected with a diseased condition of a tooth-fang; or, more frequently, with a diseased action attendant on the development of the tooth-pulp—'dentigerous cysts.' (See p. 468.)

Specimens of simple primary cysts of the jaws, commencing in the substance of the bone, may be found in some of the museums of the metropolis. They expand the bone more or less, so as to take with them portions for their outer covering or walls, the remainder of which will be generally made up of a tough membranous substance. The contents are fluid, serous, or gelatinous, and of different shades of colour. 'This disease is usually of slow growth; and there have been instances in which the tumour of the jaw, formed by it, has acquired a large size.'[2]

FIG. 129.—Cystic Tumour of the Lower Jaw. (From the Museum of St. George's Hospital.

In the Museum of St. George's Hospital may be seen a preparation (fig. 129) which well illustrates the prominent features of a simple cystic tumour of the jaw. The tumour was removed from a woman forty-five years of age. It occupied on the right side the situation of the lower jaw, and extended from the second incisor to the condyle of the bone: it formed a large globular cyst, which occupied nearly the whole of the side of the face. It extended downwards over the upper portion of the neck; and inwards, displacing the tongue; it greatly interfered with speech and mastication. The principal part of the growth was upwards and outwards towards the malar bone, which was somewhat expanded and partly absorbed. In some parts the tumour appeared of bony hardness; in others very elastic. The integument covering it was not discoloured, and there was no enlargement of the neighbouring glands. The disease had been noticed about eighteen years before admission, when it formed a small hard incompressible lump, just over the angle of the jaw: it gave no pain; and for a long time its increase was extremely slow. About six months previous to her admission, it commenced to enlarge very rapidly. The cyst may be seen in the figure to extend from the symphysis to the right condyle.

[1] See Stanley, *Diseases of the Bones*, p. 268; also, DISEASES OF BONES, Vol. I. p. 328.
[2] Stanley, *op. cit.* p. 267.

The parietes are partly osseous and partly membranous. The entire substance of the jaw-bone on this side has disappeared, and is replaced by the abnormal growth. When removed, the cyst appeared to be divided into several cells, which contained a transparent gelatinous fluid; though in the dried preparation there are but few indications of such divisions. The tumour was successfully removed; but the patient died subsequently from erysipelas.

In the Museum of the College of Surgeons there is a specimen of a cyst of the lower jaw, occupying the greater extent of the right side, and projecting outwards rather than upwards. It is oval in shape, and multilocular; the cells were filled with a glairy fluid. The diseased portion of the jaw was successfully removed.[1]

Whatever the origin of these cysts, they appear, on the one hand, independent of any tooth-irritation; and on the other, of any previous cartilaginous deposit. The diagnosis in such cases is not beset with much difficulty; and even if a doubt exist as to the nature of the tumour, it is at all times safe and easy to explore it with a trocar.[2]

In the treatment of these tumours, it is a milder and a more justifiable course to make a free incision into the cyst, and subsequently to trust to reparative action, than at once to have recourse to removal of the diseased mass.

If the cyst be large, or even if it be ultimately requisite to remove it in its entirety, the previous incision will in all probability have much reduced it in size; when the parts, if not in a better, will certainly be in no worse, condition for removal.

In both the cases related removal of the tumours was accomplished without difficulty. Two cases are mentioned by Paget, in which incisions were employed successfully; but in neither case did the bone appear diseased.

In a case under the author's care in St. George's Hospital, the cyst occupied a large portion of the left side of the upper jaw. Its anterior wall projected under the cheek, and bulged out the side of the face. A free incision was made into the cyst from within the cheek. The anterior wall was found to be partly membranous, and partly consisted of thin flakes of bone. A portion was readily removed, so that a free opening was left for the escape of the contents, which were of a glutinous consistence and brownish in colour. At the bottom of the cyst there was found projecting into its cavity the extreme point of the fang of the canine tooth. On the removal of the tooth, the fang was found to be partially necrosed. The cyst contracted and closed in a short time without any further treatment. The patient was about ten years of age, and when he quitted the hospital there was no trace of the disease left, nor the slightest disfigurement.

In all cystic diseases of the jaw, careful examination should be made of the teeth; all diseased ones near the growth should be at once removed. One of the most frequent causes of serious mischief, and still oftener of exquisite suffering, is the too long abode of defective and decayed teeth in their sockets. We feel satisfied that the greater the experience in the treatment of diseases about the mouth, the more exacting will the surgeon become respecting the removal of all useless, defective, or decayed teeth or stumps.

Fibrous tumours of the upper and lower jaw are by no means uncommon; and in their general features, in their growth, and in their varieties, correspond to fibrous tumours of other parts. 'The favourite seats of fibrous tumours of bone and periosteum are about the jaws.'[3] Such tumours may originate in the substance of the bone, and in growing, expand it, as a crust, over the outer surface of the tumour. In the Museum of the College of Surgeons there is a preparation showing a fibrous tumour of the jaw, with a thin shell of bone over it.[4] They may grow from the periosteum, and embed the bone in their surrounding mass. They affect equally the upper and the lower maxilla. They may appear early in life.

[1] Museum Catalogue, No. 1033.

[2] M. Giraldès has described a form of cyst in connection with the upper jaw, which he believes to be of very common occurrence, and to be formed by a morbid change in mucous glands naturally existing in the lining membrane of the antrum of Highmore (see his *Récherches sur les Kystes du Sinus maxillaire*): but no such origin can be ascribed to those which distend the body of the lower jawbone in the manner above described.

[3] Paget, vol. ii. p. 145.

[4] No. 1045.

Mr. Liston removed a large fibrous tumour of the upper jaw, in a woman twenty-one years of age, which had made its appearance four years previously.[1] It grew on the outer side of the jaw, and was removed six months after its first appearance, when about the size of the end of the thumb. In eighteen months a return of the disease, the size of a hen's egg, was removed, with a portion of alveolus. The growth reappeared in two or three weeks, and attained a large size in two years, which rendered necessary the removal of the whole of the superior maxillary bone. The patient recovered.

Fibrous tumours of the jaw are usually of rather slow growth; but their growth may in exceptional cases be somewhat rapid. Their usual history is one of progressive and persistent increase; perhaps more rapid in proportion to their increase of size, but, in the main, rather slow than rapid. The size some will attain is best illustrated by the collections in our various museums; and especially the preparations collected by the late Mr. Liston, now in the possession of the College of Surgeons. In some respects, as to the size which they attain, they appear to vary from fibrous tumours of other parts, and especially those of the uterus; for fibrous tumours of the jaws are not usually seen to expend their energies in growth; they are not seen to stay their course, to degenerate, or calcify; or perhaps something may be said to depend on their position, for this is such that it can never permit of sufficient increase, or life, to attain that end, without first having grown to such a size as to occasion fatal impediment to deglutition or respiration. They are usually painless in their growth, and innocent in character, as compared with cancer; but their locality as they grow renders them formidable as to disfigurement, as to discomfort, and even ultimately to life, if they be not removed before such growth be attained. It is wise, therefore to pass the verdict of early removal, when we have to pronounce judgment on such cases; the earlier the operation is performed, the less formidable will it be. We cannot hold out a prospect of arrest; but we may certainly forewarn as to the inconvenience of delay, and we may positively predict danger from increase, and at the same time offer some relief to the sufferings of the patient. An especial reason for early removal applies more to tumours connected with the upper than to those of the lower jaw. The tumour which commences in the antrum, or any other part of the superior maxilla, will constantly be found by pressure to cause the absorption of the floor of the orbit, and then to make its appearance in that cavity. By degrees the latter becomes filled by the growth, while its original contents are destroyed and absorbed. The eye itself is early sacrificed. Still expanding, the mass presses on the upper wall of the orbit, and in time surely gives rise to its perforation, in a manner similar to that observed in the wall of the antrum, and thus is ensured the contact of the growth with the surface of the dura mater. When such a complication is established, removal of the tumour is one of great hazard, if not certainly fatal.

A man was admitted into St. George's Hospital, under the care of the author, with a large fibroid growth projecting from the antrum and entirely occupying the cavity of the orbit. The eye had long been completely destroyed. There was not much doubt about the practicability of removing the mass with the whole of the left superior maxilla; and as the patient was anxious to be rid of the sufferings entailed by the presence of the growth, the author removed it without difficulty. The tumour had apparently originated in the antrum, but had no attachment to the sides or upper wall of the orbit, though the cavity was not only filled, but was also much expanded by the growth. The patient bore the operation fairly well. The whole of the left superior maxilla was removed, and with it the tumour in its entirety. Symptoms of meningitis soon set in, and the patient died in a few days. On examination after death, the upper wall of the orbit was found perforated in two places, and hence the origin of the meningitis.

In their structure we cannot point out any distinction between the fibrous tumours which attack the lower, and those found connected with the upper jaw; but, practically, there are some important considerations connected with the history of the latter to which we would especially draw attention; and a knowledge of which is most essential to any operator dealing with such cases. Fibrous tumours

[1] Museum of College of Surgeons, No. 1046.

of the lower jaw are invariably more or less globular in form; usually they have a uniformly smooth surface; their tendency is to protrude externally, more than towards the mouth: if originating in the substance of the bone, perhaps they may be found equally surrounding it; if originating in the periosteum, perhaps most prominent on the corresponding surface. Fibrous tumours of the upper jaw are often far different in their outward character, in their surrounding relations, and in the tendency they display, from position, to spread in different directions. A fibrous tumour supposed to be attached to the upper jaw may really have its origin from the base of the skull, the sphenoid, or the ethmoid bone; and from either point make its way through the various foramina and fissures, and into the various fossæ in and around the superior maxilla. Instead of a globular dense mass, as in the lower, the tumour of the upper jaw may be lobulated; or, from its very position, and as a result of its insinuation into these fissures and fossæ, it may be moulded, as it were, into a mass of pedunculated bodies, somewhat analogous to the bulbous roots of a tuberous plant; or, commencing in the interior of the antrum, it may by growth or position be pressed through its anterior wall, and puff out the cheek; or through its floor, and push down into the mouth; or into the nares, and plug up the lachrymal duct; or into the orbit, and displace the eyeball; or into all or several of these spaces, and produce corresponding deformity. So that the diagnosis of the origin of a fibrous tumour of the upper jaw is often as complicated an affair as that of the lower is easy; indeed in some cases, until the upper jaw be removed, it will be impossible to determine to which portion of the skull, or bones of the face, the growth may be attached.

The following case illustrates the force of these observations. A man twenty-five years of age was admitted into St. George's Hospital, under the care of Mr. Prescott Hewett, 'with a large tumour, of an irregular shape, occupying various regions of the left side of the face.' In the cheek it formed a swelling of the size of a turkey's egg, and filled up the greater part of the superior maxillary region; the outline of the bone was perceptible to the touch in a few places only; the zygomatic arch was much more prominent and more curved than natural, having been pushed forward by the tumour, portions of which could be felt under the temporal muscle. The diseased structure was also found, in the shape of small flattened bodies, at the lower part of the orbit, lying immediately underneath the conjunctiva, and apparently quite movable; the bones of the inner and outer walls of this cavity, as well as those forming its circumference, were not affected or displaced; but it was impossible exactly to make out the state of the bones at the lower wall, owing to the tumours which were there; the eyeball was not more prominent than natural. Portions of the morbid growth were detected in the left nasal fossa, from whence a small round mass projected slightly, at times, into the pharynx. The tumour overlapped the front part of the alveolar process, and projected beneath the lip.

About six years previous, the patient had observed what was supposed to be a polypus of the nose, which was easily removed; but some little time after the cheek began to swell, and gradually the tumour commenced to show itself in the various other positions described. Its growth was painless throughout. A year previous, caustic had been freely applied, with the idea of destroying it; and two large cicatrices marked the places of its action. At various times there had been extensive bleeding from the nose; these bleedings had somewhat reduced the patient, who was of a spare habit and pale; this paleness being attributed to a loss of blood which occurred shortly before his admission. It was decided to remove the tumour by the usual incisions for the removal of the upper jaw. The bones having been divided with cutting forceps, the superior maxillary and malar were easily tilted out of their place; when it was found that the disease was not connected with the upper jaw, but was behind it. The greater portion, which was in view, was removed; some portions were lying in contact with the pterygoid process; some portions embedded under the temporal muscle; other portions in the orbit. Before the operation could be completed, the patient became so faint that it was found impossible to proceed with the operation, and he subsequently sank.[1]

The preparation of the parts shows the superior maxillary and malar bones, and portions of the tumours extracted from behind them; the bones are healthy, but altered in shape from pressure; the tumours present all the characteristics of fibrous structure. The parts removed after death show a morbid growth, originating in the root of the left nostril, and especially on the inner edge of the pterygoid process and under surface of the body of the sphenoid bone, to which parts small portions of tumour were found still attached. The sphenoidal sinuses were filled with diseased structure of a similar character, and were very much dilated;

[1] *Med.-Chir. Trans.* vol. xxxiv. p. 43.

so much so, that at one point the bone had been altogether absorbed, and in its place was a small hole, where the tumour was lying in contact with the dura mater. A small portion of the growth was also found at the upper and back part of the septum nasi, which was forced over to the right side and partially destroyed by absorption: here the mucous membrane was somewhat thickened; and there was a small pendulous body, loosely connected to the velum palati, and hanging by the side of the uvula. Small flattened growths of a similar nature, and of a bulbous shape, were found deeply embedded in the spheno-maxillary and temporal fossæ, as well as at the back part of the orbit. None of them had any attachment to the bones; they were all connected to each other and to the growths in the nostril by a slender pedicle, which passed in the direction of the spheno-palatine foramen; the growth in the orbit had reached that situation by creeping through the spheno-maxillary fissure. The bones of the orbit were quite healthy. The preparation is in the Museum of St. George's Hospital.

The removal of a fibrous tumour with the entire portion of the jaw with which the growth is connected does not necessarily ensure an immunity from recurrence. Two specimens in the Museum of the College of Surgeons illustrate the reproduction of a fibrous growth, subsequent to the removal of a previous one.

One preparation shows the right side of the lower jaw, from the angle to the first bicuspid tooth, with a tumour of a fibrous character, two inches in its greater diameter, and situated entirely on the anterior surface of the bone, and extending along nearly the whole portion removed. Its base is osseous, and the rest fibrous.[1] The other shows the ascending ramus, condyle, and coronoid process of the lower jaw, with a tumour of a similar character.[2] A woman thirty years old had suffered from 'toothache' from nine years of age, after a blow on the cheek. The first portion of the jaw, with the tumour, was removed about five months after it was first observed; its growth had been painful, both in the jaw and the cheek, and was attended by constant headache. No portion of the disease was apparently left at the first operation. But the disease reappeared at the ramus, which was subsequently removed at the joint. The patient recovered.

Subject to this occasional tendency to recurrence, fibrous tumours may be classed as essentially innocent; largely so, in proportion to many of those which affect the jaws; if by the term innocent we intend to convey the possibility of complete eradication by operation, and, subsequent thereto, a total immunity of the part and the system from recurrence of the disease.

And yet, as in other parts, so in these, we must be prepared to meet with fibroid tumours which present many of the characteristics of true fibrous growths, but possess in addition the peculiar property, that upon each removal there appears a more rapid tendency towards recurrence, as well as greater rapidity in growth; from the true structure of fibrous tissue, as each removal takes place, there is a gradual shading off into fibro-plastic or mere gelatinous tissue; until at last rapid growth and rapid deterioration of constitution run hand in hand, and the patient sinks, exhausted by a foul ulcerating sore based on a monstrous fungoid mass. When cut into, this mass presents a smooth, gelatinous, and somewhat elastic surface; the structure abounding in serosity, and often readily breaking down; void of many blood-vessels, and of a low vitality.

Fibrous tumours of the jaw may be partly composed of bone; or partake of a fibro-cellular character, such as we find in similar tumours of other parts of the body. In the Museum of St. George's Hospital is a preparation showing, on section, a small nucleus of bone which in no part approaches the surface of the tumour.[3] Another specimen shows much bone radiating into the substance of a fibrous tumour from its base, and approaching in some parts very near the surface.

Fibrous tumours, usually of slow and painless growth, are often attended by suffering when they affect the jaws; and their growth may be sufficiently rapid to require the aid of the surgeon within a few months of their outset to obviate the serious results of pressure and encroachment on the cavity of the mouth.

'As a general rule the vascularity of a fibrous tumour is in inverse proportion to its singleness and toughness of construction.'[4] Yet, in the region of the mouth, we constantly observe a tendency to recurring hæmorrhage, to be attributed in some measure to the friction the surfaces may be subject to, or the accidental bruising they

[1] No. 1041, College Museum.
[2] No. 1042, *ibid.*
[3] Series ii. No. 155.
[4] Paget, *op. cit.* vol. ii. p. 134.

may receive, in the daily process of mastication. This hæmorrhage is not usually very great at any one time; but it has this important practical bearing, that by its amount or by its frequency it deprives the patient of much blood; he becomes blanched and reduced; and if relief be long deferred, he becomes little capable of undergoing an operation, which of itself often exacts the immediate loss of a large amount of blood. A case already related points to the principle here enunciated.

Myeloid tumours of the jaws.—What has already been said relative to the general features of fibrous tumours originating in the jaws will to some extent apply to myeloid tumours affecting these bones. They will perhaps be found to affect those parts almost as frequently as the fibrous tumours. The Museum of St. George's Hospital contains several specimens of myeloid growths connected with the maxillary bones.

The general characteristics of these growths have been well summed up by Paget. 'Myeloid tumours,' he says, 'usually occur singly; they are most frequent in youth, and very rare after middle age; they generally grow slowly, and without pain; and generally commence without any known cause, such as injury or hereditary disposition. They rarely, except in portions, become osseous; they have no proneness to ulcerate or protrude; they seem to bear even considerable injury without becoming exuberant; they may (but very rarely) shrink, or cease to grow.'[1]

A specimen in the Museum of St. George's Hospital shows a tumour about the size of a nut, with a portion of the whole depth of the lower jaw, which was removed from a girl eight years of age. Four and a half years after, she remained well.[2] Mr. Cæsar Hawkins removed a tumour of a similar nature, with a portion of the alveolus of the upper jaw, from a little girl five years of age, in St. George's Hospital. This had grown rapidly in the course of about three weeks, and was successfully removed.

The diagnosis of a myeloid tumour is always uncertain without microscopical examination of its structure. In its origin and growth, in connection with the jaws, it may be mistaken, as in all other parts which it attacks, for cartilaginous or fibro-cellular growths. Its characteristic features are most marked in its intimate structure; for an account of which we refer the reader to the essay on TUMOURS, vol. i. p. 273.

The nature of myeloid tumours of the jaw permits of no half measures in treatment; entire removal of the growth, with the portion of bone to which it may be attached, is the only safe, the only justifiable course to be pursued; and no delay should be recommended or sanctioned. As it will surely grow large when once started, it should without hesitation be removed whenever detected. The removal does not always insure safety. There is no doubt that myeloid disease is sometimes recurrent. The experience of late years has fully established this fact.

A patient under the care of the author was the subject of a myeloid growth affecting the left side of the lower jaw. Some seven years previously she had been operated on for a similar growth in the same situation. The original mass appeared to have been freely removed with a portion of the alveolus, but had been gradually returning for twelve months. This was removed by the author with as much bone as appeared to be implicated, and, as far as could be ascertained, no diseased portion was left behind, but the entire depth of the bone was not included in the removal. In the course of about three years a tumour again showed itself in the old place; and nothing remained but to remove the greater portion of the left side of the jaw. There has been no return in the lapse of five years. The mass removed was true myeloid.

Osseous tumours of the upper and lower maxillæ are not very commonly met with, but occur sufficiently often to make them especially interesting in connection with the surgery of the mouth. They will be found to occur in two different forms or characters: simply as outgrowths from the parent bone, to which a base more or less narrow or broad is attached; or as a general thickening and enlargement of a part, or of the entire bone, terminating often in considerable and even frightful malformation.

[1] *Op. cit.* vol. ii. p. 217. [2] Series ii. No. 168.

The true osseous tumour is often compact, heavy, hard, and ivory-like on section; or else more spongy or cancellous, much less hard, and much less weighty in proportion to its size. Practically, the size, the rapidity of growth, and the locality, are of more importance than the exact condition of its structure.

Osseous tumours are seldom rapid in growth; they may affect any portion of the jaws; they are not usually painful, but generally and steadily increase in size, and sooner or later their removal is rendered imperative.

In the Museum of the College of Surgeons is a preparation which shows the true character of the hard ivory-like tumour of the jaws. It is seen growing from the angle of the lower jaw, to which it has an attachment by a broadish base.[1] Another similar specimen may be seen in the Museum of St. George's Hospital.[2] The removal of these outgrowths, whether they implicate the upper or lower jaws, presents no greater difficulties than does the removal of fibrous or other tumours; excepting, that if deeply nodulated and irregular on the surface, they may be entangled in the fibres of the adjacent muscles, and require much careful, it may be tedious, dissection, before they can be cleared from the surrounding soft parts.

There remains to be considered the other condition referred to, in which the bones of the face, or any portion of them, take on a peculiar process of growth, thickening, and occasionally great enlargement.

The Museum of the College of Surgeons contains specimens illustrative of this diseased action in bone, and they demonstrate what an amount of hideous deformity may occur in the victims of this horrible disease—horrible, inasmuch as it appears perfectly beyond the control of medical treatment; and unless seated in a part readily removable, entails on the wretched sufferer a lingering malady which, though slowly, yet surely, in most cases, continues its growth until its mechanical interference with the process of deglutition, or some other complication, causes death.

The tendency of this disease appears to be, that it does not restrict itself to one bone, or one portion of a bone; but that several bones contiguous to each other may become affected in their turn, and to such an extent that all surgical interference would be quite out of the question. If, however, the disease be confined to one portion of the face, such as the lower jaw or the antrum, it may probably be relieved by operation.

This diseased action may be set up in very early life. A case is related by Paget, in which Mr. Stanley removed the superior maxillary bone in a girl, fifteen years of age, in whom the swelling had been observed to commence eight years previously.

With respect to treatment of osseous tumours generally, it will be found, as a rule, that neither local applications nor constitutional measures appear to arrest, or destroy their growth. It is but a waste of time, and trifling with the patient's confidence, to suggest anything but the entire removal of the tumour. Of course this recommendation will depend on the amount of bone implicated by the disease; but if the mass can be *entirely removed* by the knife and saw, and the operation be otherwise practicable, the removal of the tumour is most likely to be perfectly satisfactory in its results. 'It may be stated that absolute security against the reproduction of an exostosis can be obtained only by the removal of every part of its circumference. If but the smallest portion of the exterior of the exostosis, with its cartilaginous capsule, be left, reproduction of the tumour will be, at the least, not an improbable occurrence.'[3]

Experience has fully confirmed the observations just quoted; and the caution which they inculcate is, not to attempt the removal of a portion, when the whole mass of an osseous tumour may present obstacles to its entire resection. How far the hypertrophied condition of bone may hereafter prove to be subject to constitutional treatment is a fair question of experiment. The disease is not common, and opportunities are few in which the efficacy or benefit of drugs, externally or internally, can be fairly tested. The disease has certainly something more of a constitutional character than simple osseous outgrowth, and the condition is one which has been known

[1] No. 1035. [2] Series ii. No. 191.

[3] Stanley, *On Diseases of Bones*, p. 157.

occasionally to assert the prerogative of hereditary transmission. In reference to treatment, Mr. Stanley states that 'medicines have no influence upon the disease.'

In their removal by operation, there is an exception to the rule which applies to osseous tumours, that the whole of the disease must be removed; for when the deformity is the result of hypertrophy, if the whole mass is beyond removal by the surgeon, even a portion may be cut away with present if not permanent benefit. 'I know, in cases where only part of the hypertrophied bones have been removed, the wound has healed soundly over the remaining portion of them; and it has not in such instances appeared that the operation was followed by any increase of the disease.' [1]

Vascular tumours of bone are so rare, and of the jaw so few instances have been placed on record, that we even venture to express some hesitation in taking for granted that those described may not have been tumours of a cancerous nature. The entire removal of the disease is the only treatment to be recommended. As described, the disease appears to commence in early life, and to be painless; but its external characters are such that no very accurate opinion can be formed of its nature, unless it present on the surface the deep red colour produced by enlarged vessels.

Mucous tumour, or myxoma.—Virchow has drawn attention to this variety, and it will be found described in the essay on Tumours (vol. i. p. 267). They are rare in the jaw, but have been met with. They may be removed like other tumours, and are not liable to return.

Cancerous tumours of the maxillæ, and cancerous ulceration of the gums, remain to be considered.

Cancer of the bones of the mouth is by no means uncommon; it is generally of the medullary form, occasionally of the osteoid variety. Cancer of the gums is more rigidly confined to the epithelial character. Scirrhus, in its onslaughts, appears to disregard these regions; for though found as a secondary condition in bone, it has not fallen to our lot to notice it in the bones of the face; the experience of others confirms this observation.

Cancerous growths are observed more frequently to affect the superior than the inferior maxilla, and to commence most frequently in, or around, the walls of the antrum. The history during life, and the anatomy, of medullary and osteoid cancers of bone, written elsewhere in this work, apply in every minute particular to the origin, the growth, and the structure of cancers affecting the bones of the face. It is not, therefore, requisite to enter now into a minute examination of their constituents; our remarks will embrace the chief practical features to which the attention of the surgeon should be directed, so that a correct diagnosis be arrived at, and prompt measures adopted where necessary.

Age is no criterion, in the diagnosis to be formed, respecting a cancerous tumour of the mouth. We observe the disease in children, in persons of middle life, in the extreme of old age. It commences often without pain, but it rarely progresses without suffering; and in many instances the pain of cancer affecting these bones is severe beyond description. The external appearances of these tumours differ in many ways, and much in each case.

The diagnostic point, however, which always marks the difference between a non-malignant tumour and one of a cancerous nature is the more easily implication and contamination of the tissues which surround the latter; the adhesion of the skin externally, and its frequently brawny dark red and congested state being marked, especially on the surface of those which protrude much outwards.

When the disease is confined to the lower jaw, its character may be more readily and earlier detected than in the upper. If medullary, it displays a softish pulpy mass, more or less elastic; projecting, it may be, on the outer side, and bulging out

[1] Stanley, *On Diseases of Bones*, p. 5.

the chin or cheek; or on the inner side, and pushing down towards the throat; or it may uniformly surround the bone.

A case illustrative of the later condition was (1863) in St. George's Hospital, under our care. It was rapidly running its course. The patient, a man aged 46, observed a swelling on the outer side of the lower jaw four months previous to admission. The tumour rapidly increased, and, on admission, involved the bone, from the symphysis to the first molars on each side. It projected backwards and downwards to the hyoid bone. The skin over it was stretched, and partially adherent, especially at the lower and left side, where it was thin, soft, red, and pulpy; much as if the disease had nearly made its way to the surface. Some of the teeth on the left side were becoming prominent and loose. Under such conditions, it was thought best not to interfere by operation. The patient died about three months after his admission.

Occasionally the masses which project into the mouth run early into ulceration, discharge very offensive matter, and often have a ready tendency to bleed. If teeth become loose and are removed, a fungoid growth shortly fills the vacant alveolar sockets. The external parts, if the tumour projects externally, appear soon to become thoroughly implicated in the growing mass; the skin becomes bound down to the parts beneath; it becomes darker coloured, dusky red or purplish; brawny, uneven, and puckered, with soft round knobs projecting outwards; and ultimately ulcerated, when rapid destruction of structure sometimes occurs from sloughing. A foul excavated and irregular sore is thus produced. The neighbouring lymphatics frequently bear evidence of the constitutional contamination; and the cachexia of cancer is usually well marked.

When the upper jaw is the seat of cancerous growth, there is often, in its early stage, some difficulty in arriving at a correct diagnosis as to the nature of the tumour. It is often but little exposed to view; it may be entirely embedded in an osseous chamber; or compressed and moulded by osseous walls, which, in the commencement, retard or direct the course of its growth. It may project into the nostril, block it up, and, perforating the septum, pass through to the opposite side; it may commence in the anterior wall of the antrum, and project forwards under cover of the cheek; or from the outer wall, and proceed downwards over the alveolus, and upwards into the temporal fossa; or from the interior of the antrum, and make its way uniformly into the nares, into the mouth, into the orbit, outwards, and forwards, and backwards. As it grows, the bones adjacent to it become expanded to some extent; then implicated or absorbed. If it presses forwards, the cheek and upper lip become distended and puffy; the fungoid growth within increases, and protrudes sometimes, at the angle of the mouth; the eyelids become œdematous, and by degrees are closed; or perhaps, prior to this, the eyeball is pushed forwards or outwards; and the cornea, no longer covered by the lids, ulcerates or sloughs, and the contents of the globe escape. Nothing can be more hideous than the advanced condition of a medullary cancer of the upper jaw, presenting often a mass half as large as the head itself; ulcerated or sloughy on its surface; discharging horribly stinking pus, mixed with blood; and persecuting the sufferer with unabating and often agonising pain.

Rapidity of growth is a strong point in the chain of evidence which is to decide the character of such tumours. But we have already observed, that rapid growth is seen occasionally in tumours of a non-malignant character. In medullary tumours rapid growth is the rule; early attainment of size a marked feature; and the rapidity of growth commensurate with increase of size. The constitutional deterioration also is continuous. The early contamination of the skin with the tumour should surely point out to the surgeon the extreme foolhardiness of attempting to remove a mass of disease, the extent of which it is almost impossible to define; and, consequently, the satisfactory removal of which is rarely practicable, with due regard to the patient's benefit.

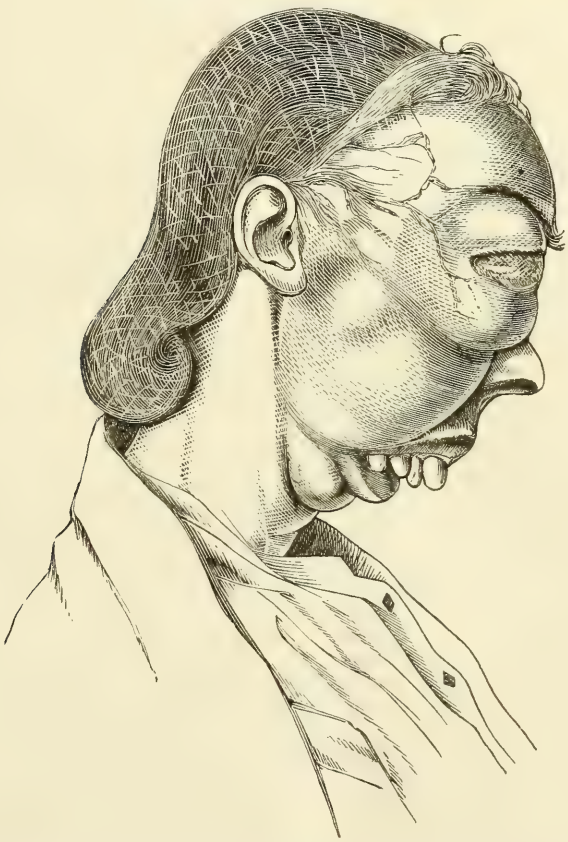
To illustrate the various points herein put forward, and to mark especially the difficulty of obtaining a satisfactory insight into the origin of such growths, as well as to indicate the utter hopelessness of attempting to remove many of them by operative interference, we wish to draw particular attention to the following cases:—We were consulted by the parents of a child, L. C., aged 5, suffering from a tumour, supposed to be connected with the upper

maxilla of the left side. The left nostril was filled up and pushed outwards; the soft palate was much pressed downwards, and a portion of the tumour could be seen at its lower edge. Some attempts had previously been made to drag away the mass; but upon each occasion alarming hæmorrhage occurred. As the disease was evidently medullary cancer, increasing rapidly, and there was great uncertainty as to its origin, it was recommended that no operation should be permitted. The child died within two months of our first visit.

The face was greatly disfigured by considerable protrusion of the left eyeball outwards and forwards, by the expansion of the nostrils, and by the projection of a fungoid mass from the left one.

The dura mater, between the sella turcica and the ethmoid bone, was thickened on its attached surface, and readily separated from the bone. The corresponding portion of bone, as well as the cribriform plate and crista, were more vascular, darker coloured, and less compact in structure than natural. The nostrils were filled with a whitish medullary tumour. It had projected in front to such an extent that it had separated the nasal bones and cartilages some distance from each other. Inferiorly, it had partially protruded through the

Fig. 130.—Portrait of a patient with Malignant Tumour of the Upper Jaw, and deficiency of the Lower Jaw.



anterior orifice of the left nostril, and had separated the palate processes of the superior maxillæ and palate-bones sufficiently to admit the point of a finger between their edges. The septum nasi was absorbed to a great extent; also the inner walls of the orbits; and thus the tumour projected into the cavity of each orbit, occupying the whole of that of the left side, where it had pushed the eyeball outwards, on a level with the anterior orbital margin. The tumour had also penetrated into each antrum. Posteriorly it had passed through the openings of the posterior nares; was in close contact with the under surface of the basilar process and the anterior surface of the upper cervical vertebræ; pressed down the soft palate considerably; and had extended into the pharynx almost as low as the epiglottis.

The above case illustrates the progress of medullary cancer of the upper jaw in childhood; the following shows how similar are the conditions in more advanced life; and both show how in each the surgeon would be foiled in any attempt to remove them. A woman aged fifty was admitted into St. George's Hospital in July 1861, under the author's care, for a tumour apparently growing from the antrum, and involving its anterior wall and the hard palate. Five months previous she had a decayed tooth removed from the upper jaw, for pain

on the left side of the face and head; immediately after which the gum enlarged, and an abscess which formed was opened, when the escape of about half an ounce of pus took place. The opening closed; but as the swelling returned, it was again lanced two days after, but on this occasion no pus escaped. From that time the swelling continued to increase, and now presented a prominent mass over the antrum and in the mouth, both in front of the alveolus and through the hard palate. The tumour grew very considerably. She suffered excessive pain. The eye, pushed forwards, became opaque, and sight was soon completely destroyed; deglutition also was difficult. She died about ten months from the commencement of the disease.

The skin was not implicated in the growth. The bones surrounding the mass were so soft, that they were readily cut with a scalpel. The tumour projected largely into the mouth; it involved the palate, the inferior turbinated, the ethmoid, the sphenoid, and the superior maxillary bones. Through a portion of the ethmoid and sphenoid bones there was an opening communicating with the cavity of the skull. The growth, with the portion of upper jaw that remained connected with it, is in the Museum of St. George's Hospital.[1]

H. W., aged 38, was admitted to St. George's Hospital under the author's care, January 1870. In July 1869, she first noticed swelling of the right lower eyelid, with neuralgic pains over the right temple and brow. After a month the eye began to protrude. In September the right cheek began to bulge out, and the right side of the nose to enlarge. The sight of the right eye had been failing for some two months prior to her admission. The mass now (April 1870) projects into the right nostril, into the right orbit, and outwards under the cheek and masseter; and bulges into the mouth to a slight extent. Hæmorrhage occasionally occurs from the nostril. The increase of the tumour is very perceptible; its aspect is represented by the engraving.

The peculiarity of this patient's condition is, that *she has no vestige of a lower jaw.* It is related by her friends that when two years of age the lower jaw exfoliated entirely; but there is now no indication of such a bone having ever existed. She has always been fed on soft food.[2]

If a cancerous tumour of the lower jaw be seen in an early condition, if it is situated near the symphysis, and the patient desire it, its removal, with the whole depth of the bone to which it is attached, may be attempted; for if situated in front, the limits may be ascertained, and the tumour dissected out entire. But if it involve the bone near the angle, we can seldom ascertain how deeply it may extend, or to what degree it involves, by infiltration, the tissues at the root of the tongue; it may extend far beyond the reach of the scalpel.

After all, it will be found that much discrimination is required on the part of the surgeon who has to decide upon the removal of a cancerous growth of the jaw; so much depends on the individual features of each case, that it would be entirely out of the question to attempt a strict code of directions relative to treatment. At best, however, interference by operation is in the large number of cases most unsatisfactory: in the few, we hope some benefit is conferred.

We cannot do greater justice to the subject than by transcribing, in conclusion, the words of Monsieur Giraldès: 'Dans le traitement des tumeurs du sinus maxillaire, il est des cas dans lesquels le chirurgien doit agir, et d'autres cas dans lesquels il est prudent de s'abstenir. Lorsque les tumeurs sont de petit volume, et surtout lorsque la constitution du malade n'est pas altérée, l'art doit intervenir, et dans ce cas, il peut arrêter le mal pendant quelque temps, et prolonger la vie des malades. Si la tumeur est volumineuse, sans que la constitution du malade soit encore altérée; si la cachexie cancereuse n'est pas développée, le chirurgien doit encore intervenir, et par deux raisons: d'abord, parce qu'il peut arrêter pour quelque temps la marche d'une maladie qui a une grande tendance à progresser; ensuite, parce qu'il peut avoir affaire à une tumeur fibro-plastique dont la malignité, dans le cas où elle serait maligne, serait toujours moindre que celle des tumeurs encephaloïdes. Lorsqu'enfin la tumeur du sinus est volumineuse, qu'elle envoie des prolongements en tout sens, que la constitution du malade est altérée, l'intervention de l'art ne ferait que compliquer un état déjà trop grave.'[3]

The gums and the other soft tissues of the mouth, if affected by cancer, are usually attacked by the epithelial variety. Commencing gradually on the surface of the former, it runs its course, similar to that species of cancer elsewhere. By degrees the ulcerated surface spreads; the borders of the ulcer present their usual thickened and elevated edges; not only the cheek, but the floor of the mouth and tongue become secondarily affected. The disease in this situation is generally very painful;

[1] The author is indebted to Mr. Charles Hunter for the post-mortem examination.
[2] The patient died soon afterwards.
[3] *Des Maladies du Sinus maxillaire*, p. 54.

much distress is occasioned by movements of the cheek or tongue; much misery entailed by constant escape of saliva; great inconvenience and often difficulty is experienced in articulation and mastication.

Epithelial cancer affecting the mouth appears to partake of a more malignant aspect than it assumes elsewhere; or rather, we might say, its local position renders it an obstacle to the requisite supply of food; consequently the life of the patient is sooner terminated. The glands in the sub-maxillary and cervical regions will often be found to be early implicated in epithelioma of the mouth; under such circumstances operative interference would not be justifiable. But should the condition of the patient, with the absence of gland enlargement, and the situation of the disease, indicate any hope of relief from an operation, the surgeon must exercise his judgment in deciding to carry it out. As a rule, however, the results are not satisfactory. The treatment to be adopted locally should consist of gargles, to obviate the distress occasioned by offensive discharges; constitutionally, anodynes to lull the pangs which constantly dart through the parts affected.

Operations.

As operations for the removal of the lower or upper jaw, or any portions of them, have been fully described in all treatises on Operative Surgery, we feel that there is nothing new to record in the following observations. Our notice of the diseases of the jaws would, however, be incomplete were we not to lay before the reader the general rules he should observe, and the manner in which he should proceed, when called upon to operate on either of these bones.

Operations in diseases of the lower jaw may involve the removal of but a small portion of the bone; of a large portion of its anterior division; of one half—from the symphysis to the condyle; or rarely of the whole bone, with both articular processes. There is considerable difference in the method of proceeding under these various conditions; but chiefly as regards the external incisions required in each.

A small tumour may occupy only a portion of the anterior part of the lower jaw, and the growth be found connected with the alveolar edge without affecting the bone to a greater depth; extending perhaps further laterally than downwards. It may have involved the alveolar process to such an extent, that the corresponding teeth are loose or have been pushed out. A case in which a tumour (fibrous) affected the lower jaw to the extent of the four incisors, came under our care a few years ago. The tumour was firm and painless, and involved about half the depth of the jaw. The canine teeth were removed; a saw was then used to cut down on each side of the tumour, through half the depth of the bone; then, with a pair of cutting forceps, the upper half of the bone, between the lateral cuts, was taken away with the tumour still adherent to it. Sir W. Fergusson relates a case in which he removed a much larger portion, in breadth, of the lower jaw, by a similar operation.[1] He justly observes, that the advantages of being able to leave the lower half of the bone are very considerable; for the lower jaw retains its shape, and false teeth can be readily adapted to it when the parts are healed. When, under these circumstances, the tumour is small, no external incision is requisite. In the case alluded to, Sir W. Fergusson was obliged to expose the tumour by making incisions from the angles of the mouth to the base of the lower jaw. If the operator can possibly avoid cutting through the lip, he should by all means do so; and it will be found that, by drawing the lower lip down, separating it from the bone, and with retractors pulling upon the angles of the mouth, a considerable surface of the anterior part of the bone may be exposed, without any external incision. Instead of two incisions through the lower lip, when a tumour has to be removed with the anterior portion of the jaw, one incision in the median line may suffice: it can be carried down below the chin without any obstacle or objection; and this allows the flaps to be drawn well over to either side, so as to expose a considerable portion of the bone. The downward

[1] Fergusson's *Practical Surgery*, p. 668.

extension of the incision also affords a ready escape for the future discharge from the wound.

When a tumour involves the whole depth of the bone, and this has to be removed with the morbid growth, the external incisions having been made, the flaps must be cleanly dissected from the tumour, to expose a sufficient surface of healthy bone on each side. In order to enable the surgeon to cut where the tissues are sound, the teeth should be removed where the bone is to be divided. The anterior surface being denuded, the posterior has to be freed from attachments of muscles, &c. Prior to passing the knife behind the bone, the tongue must be secured; a strong ligature should be passed through its apex, and held by an assistant. Of course this is only requisite when the muscles are detached at the symphysis. If this precaution be neglected, the tongue is apt to fall back on the division of its muscles, and the patient runs the risk of suffocation. The ligature may be removed a few hours after the operation; in the meantime it should be held by an assistant, or otherwise secured on the face. A large fibrous tumour of the lower jaw was removed in our presence, with more than half of the bone, without any attention being paid to the tongue; the patient appeared choking, when the tongue was seized with a pair of forceps, drawn forwards, and immediately secured with a needle and thread, and the patient again breathed with comfort. If the tumour be very large, and irregular on its posterior aspect, it is better first to cut through the jaw, and subsequently to detach it with the tumour. The isolated portion of the jaw can thus be turned forwards, and the mass dissected from the soft tissues at the floor of the mouth, commencing within from above downwards. The method of dividing the jaw is simple, if properly performed. The outer shell of the bone should be notched with a fine saw, and then the bone cut through with a pair of strong bone-cutting forceps. When a tumour implicates the side of the lower jaw, or runs near to or involves the ramus, the external incision, to expose the bone, should differ from that described. If it be requisite to disarticulate the bone, the external incision should commence just above and over the corresponding temporo-maxillary joint; be carried down to near the angle; then turned forwards to the side of the chin and (if the tumour extend far forwards) towards the border of the lip, and terminate within a little of its free margin. The integuments of the side of the face included in this line of incision are now to be dissected upwards. The incision has crossed the facial artery; and as the flap is dissected off, the artery must be divided; it had better at once be tied, to save loss of blood. The bone immediately in front of the diseased mass has then to be divided, as described. The portion to be disarticulated must now be seized and drawn outwards; some force may be requisite to effect this. As the bone is drawn outwards, the mucous membrane and muscles are to be detached from its inner surface. The knife has only to be kept in close contact with the bone to effect this, and to avoid all unnecessary danger. As the articulation is approached, the bone should be still pushed forcibly outwards; the point of the knife made to cut close to it, and care taken, in cutting through the ligaments of the articulation, not to let the point be carried inwards, or out of sight. The external carotid or the internal maxillary may readily be wounded, if this precaution be neglected. If disarticulation be not requisite, in consequence of the tumour not extending to the condyle, the external incision need not be carried quite so high on the side of the face; but, in other respects, should be made in the direction just described. The bone, however, will have to be divided behind, as well as in front of the tumour. In a case under the care of the author, about half of the right side of the lower jaw was implicated by a growth, which proved to be a round-celled sarcoma. For its removal, the external incision was confined to a line drawn along the lower border of the inferior maxilla from its angle to the symphysis; the cheek was then dissected up freely, and the bone divided from below, just in front of the angle and also close to the right of the median line. Subsequently the detached piece was readily separated from the inner attachments, and the wound brought together by sutures. Very little disfigurement followed. If the division of the lower lip can be thus avoided the disfigurement will of course be very much

lessened than if cut through. The remaining stages of the operation are comprised in securing all bleeding vessels and in bringing the edges of the wound together. Silver sutures are probably most useful here. They should be introduced at frequent intervals, so that the corresponding portions of the side of the face be accurately adjusted to each other. The extreme vascularity of the tissues generally secures rapid union and a speedy recovery. The inner surface of the cheek should be supported with a fold of wet lint. The dissevered muscles soon adapt themselves to their novel duty, and within twenty-four hours are capable of supporting the tongue sufficiently to enable it to perform its usual offices, without fear of its retraction towards the pharynx. The chief inconvenience as regards the portion of the jaw which is left is, that it is apt to be drawn inwards. But if a thin cap of metal be prepared previous to the operation, so that the upper and lower teeth can be secured by it, it may be applied, as soon as the operation is completed, with great advantage. It steadies the parts, and does not interfere with the administration of food. This latter should be fluid, and may easily be sucked in between the lips, without separating the teeth on the sound side. The jaw should be supported by a handkerchief or bandage passed under the chin, and fixed over the head. Formidable as these operations may occasionally be, patients usually convalesce satisfactorily; nor is the disfigurement subsequent to the removal of a large portion of the lower jaw, or even the whole bone, so great as might be expected. In men the cicatrix can be partially hidden by whisker and beard; and in women a little artificial ornament will readily conceal the greater part. The material deposited in the situation of the original bone assumes a shape much like that of the jaw itself; becomes firm and fibrous, and able to support a plate with artificial teeth.

If the whole of the lower jaw is to be removed, the incision should extend from one side of the face to the other. Starting from over the articulation, the incision, on arriving at the chin, instead of being carried up towards the lip, should be carried onwards to the opposite angle of the jaw, and then upwards to the condyle. This is a formidable operation. If practicable, considerable facility may be obtained by dividing the symphysis immediately after the exposure of the surface of the whole bone. This step will be found to accelerate, and render much less complicated, the separation of the muscles and soft tissues from the inner surface of the bone and tumour, and especially aid in the more rapid disarticulation of each condyle.

The extensive incision necessary for the removal of a large portion of the lower jaw unavoidably passes across and divides the larger branches of the portio dura; the result of which is loss of power over the cheek, and a drawing over of the mouth to the opposite side. This disfigurement at first is generally considerable; but appears usually to improve by time, though it rarely entirely disappears. Mr. Syme succeeded in removing a tumour confined to the ramus of the jaw by a modified incision on the side of the face, commencing over the tumour, and continued down towards the angle, and then forwards, without cutting into the mouth. The ramus, with the condyle, was successfully removed.[1] During operations for removal of tumours connected with the lower jaw, the patient should sit up rather than lie down. The blood thus escapes externally, more readily than into the throat. We should not do justice to British surgery did we omit to mention that Mr. Anthony White, Surgeon to the Westminster Hospital, was the first to remove a portion of the lower jaw. In 1804, it appears, he set the example, and thus established the practicability of the operation.[2]

The operations requisite on the upper jaw vary according to the nature of the disease affecting it, and the extent to which the walls of the antrum are implicated thereby.

Small tumours growing from and involving the alveolar processes may be usually removed without external incision, as described in the lower jaw. Cysts of the antrum or gums may be attacked with trocar or knife, by first pushing up the lip, or drawing upon the angle of the mouth. But when it becomes necessary to remove a

[1] Syme's *Contributions to Pathology and Surgery*, p. 21. 1848.
[2] *Medical Gazette*, 1846, vol. ii. p. 529.

portion of the superior maxilla, the direction and extent of the external incisions are very important. When the tumour is small, and it is supposed to be limited to the inner surface of the antrum, or projects from thence into the nostril, an incision through the middle of the upper lip into the corresponding nostril, continued upwards from the attachment of the ala for an inch or more along the side of the nose, will enable the surgeon to dissect off a considerable flap, and uncover a very large portion of the superior maxillary bone.

When it is considered requisite to remove the whole of the superior maxilla with a large tumour, a second incision to that described will be requisite. This second incision must be carried through the cheek, from the inner surface of the angle of the mouth, obliquely to the prominence of the malar bone; or if the tumour be very considerable, and implicates the malar bone, the incision can be run outwards over the zygoma; an ample flap may thus be secured, when the soft parts are dissected upwards from the anterior surface of the bones.

If, when the requisite incision is made, and the bone sufficiently exposed, it should appear that the disease is confined to the inner wall of the antrum, or growing from it into the nostril, the nasal bone should be cut through, and turned partially to one side, without entirely separating it from its periosteal attachments. Thus the nostril will be laid fully open, and the tumour can perhaps be removed without cutting away more bone. If this measure be successful, the nasal bone may be replaced, the flap of skin brought over it, and secured with sutures.

If the disease is found to affect the lower half of the antrum, and the orbital plate is free, then the latter may be left, and the former removed. The incisor teeth of the side affected having been extracted, the alveolus in front should be partially divided with a small fine saw; the surgeon cutting from the nares downwards. The cutting-forceps should complete the division of the bone backwards with that of the hard palate. A line of incision had better first be made along the mucous membrane of the latter, on the side of the median line which is affected by the disease. Then the bone immediately below the margin of the orbit, and from the nostril to the outer edge of the malar bone, must be cut through with saw and bone-forceps, and the attachments of the soft palate separated with the scalpel. The portion of bone to be removed should then be seized with strong forceps, when, by means of a few additional cuts with the knife, the surgeon will be able to dislodge the lower portion of the maxillary bone, with the tumour attached.

If it be requisite to remove the whole of the superior maxilla, the external incision which extends in the direction of the zygoma must be continued backwards sufficiently to allow of the free exposure of the zygomatic process of the malar bone. When the flap of the cheek has been freely dissected upwards to the margin of the orbit, the floor of the orbit must be cleared carefully of the attachment of the inferior oblique muscle, &c. The zygomatic process of the malar must be notched with the saw; the alveolar ridge similarly treated; and then the bone-cutting forceps employed. One blade of the instrument should be introduced into the nostril, the other at the inner and inferior portion of the orbit; great care being taken that the eyeball is not injured. The blades of the forceps should cut through the nostril and floor of the orbit to the spheno-maxillary fissure; the malar bone should be cut through its middle, right back to the anterior extremity of the same fissure; and the hard palate, on the same side of the septum nasi, should be cut back to the posterior border. Thus the tumour and bone will now only be held by a few attachments of soft tissue, which the knife easily separates. The bone can then be removed with slightly forcible manipulation, or by twisting it in the grip of a pair of strong forceps.

The hæmorrhage in such an operation is usually greater from the flap than from the rest of the exposed surface; but generally subsides in a short time, so that many ligatures are rarely requisite. The hollow left by the removal of the bone should be partially filled with wet lint, and the edges of the flap secured as already described. In such operations the patient should sit in the upright position, that he may readily get rid of the blood from his mouth.

Tumours of the upper jaw vary so materially in size, in prominence, and direction, in their point of origin, and in many other circumstances, that, in the direction and extent of the external incisions, much latitude must be given, and much left to the judgment of the surgeon. Langenbeck has described several operations for the removal of tumours of the face. The peculiarity of these operations is, that he has endeavoured to separate the periosteum from the bone (when necessary to remove the latter), and to preserve the former in connection with the soft parts. He believes that he has obtained recovery without deformity by so doing; while, if he had removed the periosteum, deformity would have resulted.

He has also adopted an operation, which he terms osteoplastic resection of the upper jaw. This operation is performed when the origin and growth of the tumour is behind the superior maxillary bone, but cannot be reached without displacing that bone.[1] Instead of removing the superior maxilla entirely, the requisite external incisions are made down to the bone at once, the bone sawn through in the same incisions, and the portion thus partially detached forcibly turned inwards, without otherwise dividing it from its connections with the nasal and frontal bone. The tumour is then removed from behind the bone, and the latter replaced in its original position. No incision is made at the place where this fracture or bending must necessarily occur.

Langenbeck's observations, and the cases he records, are too lengthy for us to introduce here; we must therefore refer the reader to the original.[2]

Diseases of the Pharynx.

Congenital defects of the pharynx are rare, and when they occur are associated with such other conditions of the fœtus as to render them incompatible with life; so that no practical importance attaches to their consideration.

Inflammation of the pharynx is generally a continuation of a similar condition of the fauces and soft palate, but is, though very rarely, seen to exist alone. When complicated with inflammation of the fauces and glottis, the inflammation appears to partake of the erysipelatous and diffuse character, and often terminates in purulent infiltration of the cellular tissue.

The general conditions indicative of this form of inflammation are described in the essay on Diseases of the Larynx. Difficulty in swallowing; laboured respiration; swelling of the throat, often observed externally; swollen and rounded uvula and margins of soft palate, hiding from view all behind them, are the prominent symptoms. The tongue soon becomes brown and dry, the lips covered with sordes. The patient dies suddenly in a spasmodic effort to respire, or gradually sinks. Usually death takes place at an early period, and often sooner than may be anticipated. A patient, well to-day, is attacked in the evening with sore throat and difficulty in swallowing; these symptoms are soon followed by great obstruction to respiration, entire loss of sleep, rapid pulse, and hot skin; in the course of three days, or four at latest, with all his faculties clear, and while able to direct by motion or writing those around him, the patient's head falls back, and he is dead.

If the parts be examined after death, there will be found œdema of the sub-mucous areolar tissue, around and in the substance of the constrictors, and travelling down around the œsophagus as low as the cardiac extremity. Often the areolar tissue is the seat of purulent infiltration. The treatment of such cases is most frequently hopeless. As long as the patient can swallow, as long as the mischief stops short of purulent infiltration, there is hope of recovery, and encouragement to persevere with the administration of stimulants and nutritious fluid food, if they can be swallowed; or with enemata of wine, quinine, and beef-tea. Laryngotomy should be performed when danger of suffocation becomes evident, or if the patient is suddenly attacked by spasm of the larynx threatening immediate death. Even if the benefit from

[1] As in Mr. Hewett's case, referred to on p. 531.
[2] *Deutsche Klinik*, 1859, No. 48, p. 470; and 1861, No. 29, p. 281.

laryngotomy be not permanent, it affords much immediate relief to the distress of the symptoms, and certainly prolongs life in most cases.

W. S., aged 45, was admitted on the 29th of September, 1845, into St. George's Hospital, with difficulty of breathing and swallowing, and all the symptoms of diffuse cellular inflammation, extending down the pharynx and œsophagus. On the 2nd October, at five A.M., he was attacked with a paroxysm of dyspnœa, and became quite black in the face and insensible. Laryngotomy was at once performed; and after artificial respiration had been kept up some time, consciousness returned; but it was found that the patient was utterly unable to swallow anything, and he died the following day. The effusion of lymph extended from the cellular tissue round the glottis downwards around the œsophagus, in the anterior as well as the posterior mediastinum, as low as the diaphragm.[1]

It will be evident to the reader with the above case before him, that when the mischief extends beyond and below the pharynx, and the infiltration is of a purulent character, no possible advantage can be derived from any form of treatment. The patient dies, either in a paroxysm of dyspnœa, or poisoned by the pus locked up in the cellular tissue of the thorax.

Abscess of the pharynx is an occasional occurrence; is generally a formidable evil; and is often as a cause or result connected with some disease of the cervical vertebræ. Much care must be taken to arrive at a correct diagnosis of such a case; for it may readily be mistaken for a polypoid or other solid growth of the walls or cavity of the pharynx.

The following case well illustrates the importance of this precaution:—An abscess, the size of a pigeon's egg, was situated between the bodies of the upper cervical vertebræ and the back of the pharynx, but from being flattened in front did not cause any material projection of the posterior wall of the pharynx. In connection with the abscess, a second small cyst was prolonged forwards, so as to form a nipple-like swelling in the pharynx; and this compressed and completely closed the orifice of the glottis. The aperture of communication between this process and the body of the abscess admitted the point of the little finger; and the whole swelling was freely movable and perfectly translucent at its extremities and sides. This abscess occurred in an infant seven months old, who had suffered from dyspnœa for three weeks. The difficulty of breathing became very urgent three days before death; was constant, though less urgent at intervals; but the slightest exposure to cold, any motion or excitement, brought on a recurrence of threatened suffocation, attended by a peculiar croupy inspiratory sound. There was no attendant difficulty of swallowing, and no other disease was found after death.[2]

Abscess may arise from an injury to the pharyngeal membrane, caused by the passage or the impaction of a foreign body. In the Museum of St. George's Hospital is a preparation which shows an irregular ulcer, communicating with an abscess, on the posterior wall of the pharynx, which was removed from the body of a young woman who died from its effects, and who had, some six weeks previous to her death, swallowed some pins, one of which was supposed to have lodged in the pharynx, and produced the mischief which so speedily terminated in death.

Ulceration of the mucous membrane of the pharynx is usually the consequence of syphilis; more rarely it is the result of scrofulous influence. In children, the latter condition is sometimes observed to produce considerable destruction of the soft tissues, and its progress is very difficult to control. The symptoms generally are, offensive breath; offensive purulent secretion from the nostrils, and excoriated nasal apertures; constant cough; and the external characteristics of a strumous diathesis. The ulceration is readily seen when the mouth is opened; is not deep, but irregular, and the edges of the ulcer usually well defined; with crusts of dried secretion, often highly offensive, sticking in patches to its surface. There is not much pain complained of; perhaps some, less or more, is experienced when food is taken.

This characteristic form of ulceration is extremely obstinate in duration, and often extends to the tissues of the soft and hard palate, as well as to the nares. In the case of a little girl in St. George's Hospital, the mischief spread most unrelentingly from the pharynx to the nose and mouth, and from the mucous surface to the deeper tissues; until the nose fell in, and the greater portion of the palate, soft and hard, was destroyed, leaving the child a dreadfully disfigured object.

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[1] *Post-mortem and Case Book*, 1845, No. 234.
[2] *Transactions of Path. Society*, vol. i. p. 61.

This strumous form of ulceration is certainly found to exist in children more frequently than in adults. The treatment is to be directed chiefly to constitutional measures, though local applications may also prove beneficial. It should consist of the various tonics which are beneficial in the management of scrofulous cases generally, aided by good living, great attention to cleanliness and pure air, and, if within the means of the patient, a sea-side residence; the Isle of Thanet is especially to be recommended.

Syphilitic ulceration of the pharynx is very commonly observed, especially in the lower classes of the metropolis. It is constantly seen to attack the posterior wall of the pharynx; but is usually accompanied by ulceration of the velum or tonsils, or some other secondary evidence of the prevailing poison.

Its character may be suspected by the age of the patient, the period of its duration, and other symptoms which may be present; *i.e.* rupial sores in the skin; nodes of the skull or other bones: pains in the limbs or joints; general reduction of health and flesh; and last, not least, the confession (not always to be obtained) of a former primary sore, with perhaps a mark of its recent habitation.

Such an ulceration will usually yield rapidly and satisfactorily to treatment. It granulates, contracts, and cicatrises under the influence of iodide of iron, or iodide of potassium alone: and if thus treated in its earlier conditions, leaves behind but little to mark locally its former existence.

It happens, however, in some instances—whether from neglect, or from misapplied treatment, or from a state of deteriorated constitution—that there arises a greater virulence in this ulcerative action; and that the ulceration spreads not only to the sides and posterior wall of the pharynx, but also implicates the velum and arches of the palate, leaving a very extensive surface entirely denuded of mucous membrane. Under such circumstances, the patient will be found in a deplorable state; he has great difficulty in swallowing, and he becomes greatly reduced from inability to take sufficient nourishment. When, under judicious treatment, cicatrisation commences, it will generally be found that as the ulcerated surface contracts, the soft palate becomes displaced, and adherent by its margins to some portion, or occasionally to the entire surrounding surface of the pharyngeal wall. As a result, the soft palate has been occasionally seen adherent to and continuous with the wall of the pharynx, so that all communication between the latter and the nares was entirely cut off. An operation should be attempted partly to relieve this evil; there is usually much difficulty in again preventing adhesions of the parts during cicatrisation; but as the sense of smell is very much impaired as long as the communication between the two cavities is closed, it is most desirable to establish a permanent aperture in the soft palate under such circumstances; and in all probability the perseverance of the surgeon in his efforts to effect it will ultimately prove successful.

Dilatation of the pharynx may occur in two forms: it may be dilated throughout, or only partially. The latter condition is met with occasionally: the former very rarely. The symptoms noticed in cases in which a pouch has been found after death, are difficulty in swallowing much food, and vomiting of food which has been felt to stick in the throat. In one case,[1] the patient (who died at the age of ninety) was accustomed to press on the pouch and force the food into the œsophagus.

In the Museum of St. George's Hospital is a specimen showing dilatation of the lower part of the pharynx, at a point corresponding to the lower border of the inferior constrictor muscle, and forming a pouch equal in size to that of an egg. The pouch projects downwards behind the upper part of the œsophagus: it is apparently composed of a portion of the mucous membrane and sub-mucous tissue protruding through the muscular coats of the pharynx, and does not show any muscular fibres entering into its formation. The upper portion of the pharynx is enlarged, and the pharyngeal muscles are hypertrophied. There is no stricture of the œsophagus.

The preparation was removed from the body of a man aged sixty-three, who for several years had suffered from difficulty in swallowing. After the conclusion of a meal he was in the habit of returning small portions of food. For two or three years previous to his death

[1] Museum of Royal College of Surgeons, No. 1886.

he was subject to attacks of inflammation of his larynx, from which he recovered under treatment. His death was the result of inflammation of the lungs. The dysphagia was always supposed to be owing to stricture of the œsophagus.

Tumours attached to the pharynx are not very common. When they occur, they are generally apt to be somewhat pendulous, and are often attached to a portion of the walls by a narrow neck. They have been found to consist of fat, fibrous or fibro-cellular tissue. But the character of the growth is perhaps of less importance as regards the immediate treatment, than the shape, the size, the position, and the attachment of the mass.

The record, with a coloured illustration, of a fatty tumour of the pharynx, is to be found in the 'Transactions of the Pathological Society,' vol. v. p 123, by Mr. Holt. This specimen was removed from the body of a man eighty years of age. Twelve years previously, his attention had been first drawn to his throat, from an occasional sensation of choking. About four years previous to his death, during an attack of vomiting, a large mass was protruded into his mouth; and, to prevent immediate suffocation, he was compelled to return it as quickly as possible. He was at all times better able to swallow fluids than solids. He died suddenly, while in the act of smoking.

The tumour was found to be a large, pendulous, fatty mass, filling the pharynx, and extending downwards to the œsophagus for nine inches. It was attached by fibrous tissue, covered by mucous membrane, to the left side of the epiglottis, and also to the upper part and side of the pharynx. The tumour had by its weight so dragged upon the epiglottis, that the perfect closure of the laryngeal aperture was not practicable. The mass, except at its attachments, was hanging loose in the pharynx and œsophagus. It consisted of adipose tissue.

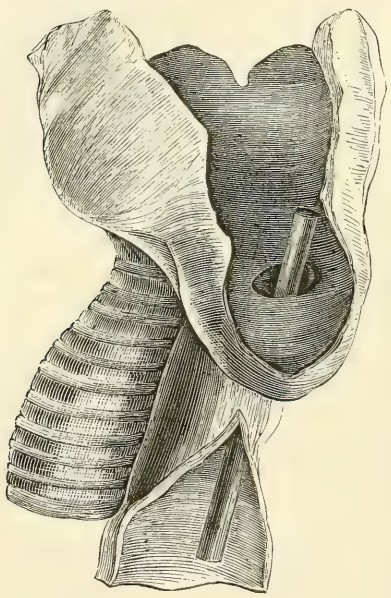


Fig. 131.—Pouch of the Pharynx. (From a preparation in the Museum of St. George's Hospital. Ser. ix. No. 14.)

In the Museum of the College of Surgeons are two specimens of tumours of the pharynx, successively removed during life. One [1] is a large, soft, lobulated mass, apparently fatty or gelatinous, like a nasal polypus. It was attached by a narrow pedicle behind the tonsil. A second [2] is apparently a firm, fibrous mass, and was attached by a narrow pedicle to the wall of the pharynx.

Other cases have been observed in which tumours, either of fatty or fibrous structure, have encroached on the cavity of the pharynx without becoming pendulous; they have been seen to grow and insinuate themselves under the mucous membrane; and as they increased in size, so they interfered with the aperture of the glottis, and interrupted the passage of food to the stomach.

The treatment of tumours located in and attached to the walls of the pharynx is often attended by some difficulty, but their removal should be attempted, and that at as early a stage as possible.

The only hope of benefit must be from treatment restricted to the pendulous form of tumour. The attempt to remove a tumour attached throughout to the walls of the pharynx would be a highly hazardous proceeding, and most probably unsuccessful in its results, if not fatal during its progress. When the tumour is pendulous, no time should be lost before the endeavour be made to remove it. If not large, and attached to the upper part or side of the pharynx, it may be seized with a vulsellum, and the pedicle cut through with a knife. If the mass appears very vascular, or large vessels are detected running through the pedicle, a double ligature may be first passed through the base, and when securely tied the mass may be with safety cut off beyond it. A ligature through the pedicle is far preferable to one round it; for when the mass beyond is removed by the knife, the ligature is apt to slip off, and possibly some hæmorrhage might ensue.

[1] No. 1090. [2] No. 1091.

The chief, and probably the only risk the surgeon has to fear in an attempt to remove a polypoid mass from the pharynx is that of suffocation, produced either by the mass itself filling up the fauces and pressing down the epiglottis, or by spasm of the glottis, the result of irritation from the tumour coming in contact with the surface of the laryngeal mucous membrane. This risk, however, may be effectually guarded against by the use of the tracheal 'tampon.' This apparatus should be employed in any operation in which there is danger of suffocation from pressure of the tumour on the orifice of the larynx, or of the chance of much blood passing down the trachea and thus embarrassing respiration. Under these circumstances tracheotomy has first to be performed, and then the tampon fixed at the opening around the tracheal tube. By the adoption of these measures, the entrance of blood into the bronchi is effectually prevented, while respiration is in no degree interfered with. If the character of the tumour recorded in the 'Transactions of the Pathological Society' by Mr. Holt be considered—its attachments, its size, and the extreme feasibility of its removal, either in great part or in its entirety, that it could not have been drawn into the mouth without the aperture of the glottis being stopped up, but that otherwise the mass might easily have been drawn forwards, and the greater portion removed, the important aid of this instrument will be at once appreciated. It might be necessary or desirable to retain the tube for a few days, or until the wound occasioned by the removal of the tumour had commenced to granulate and contract.

Diseases of the Œsophagus.

Congenital malformation of the œsophagus is rare. It usually proves fatal within a few days of birth.

Dilatation of the œsophagus, and *pouches* connected with that tube, are of occasional occurrence. Cases of the former have been put on record by Rokitansky [1] and by Dr. Barker.[2]

Contraction of the œsophagus is a very common evil. It is usually an insurmountable difficulty to the surgeon, and in the majority of cases rapidly reduces and destroys its victim.

Contraction, or 'stricture' of the œsophagus, may be the result of several distinct conditions. Folds of the mucous membrane; cicatrices after injury; pressure occasioned by aneurism or tumour; thickening and contraction of the walls; or, lastly, and most frequently, cancerous affections of the tube, are the chief causes of stricture of the œsophagus.

In the Museum of the College of Surgeons is a specimen (No. 1079) which shows stricture of the œsophagus from a fold of mucous membrane. Just below the cricoid cartilage, the œsophagus gradually contracts to half its diameter, and then dilates. The mucous membrane at the contracted part forms transverse, sharp-edged, and projecting folds, which pass round the chief part of the circumference of the tube. The surrounding tissues are also condensed, as if the result of cicatrix. There is no history to the specimen. Another preparation (No. 1080) shows a very similar condition in the œsophagus of a child, probably the result of some acrid substance having been swallowed. A preparation removed from the body of a boy ten years of age shows a contracted state of the œsophagus, subsequent to the action of sulphuric acid swallowed during life. With respect to the changes subsequent to the passage of an acrid poison over the mucous surface of the œsophagus, Rokitansky remarks that when 'the mucous membrane has been destroyed by the energetic action of the poison, it is replaced by serous and sero-fibrous tissue, which gives rise to peculiar valvular strictures of the œsophagus, somewhat analogous to those consequent on dysentery.' [3]

In the Museum of St. George's Hospital is a preparation of a portion of an œsophagus, in which may be seen a constriction about three inches from its upper extremity—the result of a piece of bone becoming impacted for a time in the passage, and having set up inflammation around the part. This mischief extended to the præ-vertebral areolar tissue of the cervical region, followed by ulceration of the intervertebral cartilage of the third and fourth cervical vertebræ. The ulceration went on to perforation of the spinal canal, and produced

[1] *Path. Anat.* vol. ii. p. 8. [2] *Path. Soc. Trans.* x. 140.
[3] *Op. cit.* vol. ii. p. 10.

inflammation of the membranes and softening of the spinal cord. The piece of bone, of considerable size, had stuck in the throat for a time, but was subsequently removed. Large quantities of pus were afterwards spat up.[1]

Simple stricture of the œsophagus, from thickening and contraction of its walls, is occasionally met with, and apparently without satisfactory explanation. Mr. Liston exhibited at the Pathological Society a specimen possessing some interesting features. The stricture existed at the upper part of the tube, was about an inch in length, and only capable of allowing the passage of a goose-quill. The contraction had existed for a number of years; there was considerable hypertrophy of the constrictors of the pharynx, especially of the superior one. The upper horns of the thyroid cartilage were so approximated as to leave but a space of $\frac{5}{8}$ths of an inch, being a diminution of about an inch in the breadth of the natural interval between them. The patient had been under the care of Cruikshank and John Hunter, and lived to between seventy and eighty.

It is unnecessary to multiply instances of these forms of contraction; there are, however, certain circumstances in connection with their progress, which will form the subject of consideration when their diagnosis and treatment are discussed.

Complete obstruction to the passage of food from the pressure of a tumour on the œsophagus is very rare. Occasionally some degree of difficulty in swallowing is experienced, from the presence of a tumour of a cancerous nature; or from the thyroid, when very large, or when it wraps round the trachea; or from an aneurism or any other kind of swelling in the neck.

Evidence of supposed pressure from a tumour must, however, be carefully weighed before a decision be arrived at respecting its influence in this respect. Dr. Wilks[2] has very properly drawn attention to the circumstance that obstruction has been attributed to an exostosis of the vertebræ when actual disease of the œsophagus and stricture existed above the seat of the exostosis.

The most frequent causes of obstruction to the passage of food, attended by rapid deterioration, and followed by early death, are cancerous affections of the œsophagus. They occur in various forms. The epithelial variety of ulceration with contraction is most common, but medullary, villous, or colloid cancer occur somewhat in proportion to the order in which we have placed them.

Cancerous ulceration or stricture of the œsophagus is a disease of age. We are not aware of its occurrence in youth or early life. Rokitansky states that 'cancer of the œsophagus generally occurs in an isolated form, *i.e.* without the co-existence of the disease in other organs.'[3] Such is no doubt often the case, but the rule is made too general to be correct; the reader may satisfy himself that we differ with the great pathologist on reasonable grounds by reference to the 'Transactions of the Pathological Society.'

The usual symptoms of stricture are, first, a slight difficulty in the passage of solid food to the stomach. The difficulty gradually increases; sooner or later the patient is compelled to restrict himself entirely to food of a fluid form. By degrees he finds that this he can take only in gradually reduced quantities, until at last he sips but a few drops at a time; or even this small quantity may be rejected, shortly after an attempt made to swallow it.

A patient with organic stricture of the œsophagus rapidly emaciates, unless food can be introduced into the stomach by aid of a tube; the circulation becomes feeble, he complains of a sensation of cold on temperate days, and he becomes very susceptible to all changes of the atmosphere.

If there be ulceration in the upper part of the œsophagus, or the pharynx be also implicated, there is generally a disagreeable smell in the patient's breath, easily detected by a visitor on entering the room. The patient is often subject to expectoration, and the secretion spat up is semi-purulent, and occasionally very offensive. He complains of intense hunger in the earlier period of the disease, and when solid food can no longer be taken; but gradually he succumbs to the privation, and latterly is often indifferent respecting it.

When once the contraction of the stricture restricts the patient to fluid nourishment alone, the quantity taken is by no means sufficient to sustain life; so that should not some means of relief be adopted the medical attendant may predict the

[1] *Post-mortem Book*, 1852, fol. 36. [2] *Path. Soc. Trans.* vol. xii. p. 101.
[3] *Pathological Anatomy*, vol. ii. p. 12.

approaching end as not far distant, when perhaps the patient or his surrounding friends may be little prepared for such an announcement.

Occasional complications occur in the progress of stricture of the œsophagus to which our attention is requisite; they render the disease more distressing to the patient, but generally hasten the termination of his sufferings. The epithelial variety of ulceration is apt to spread superficially, without destroying the tissues deeply; and though a large surface may be implicated, the patient so affected will survive longer than one affected by the medullary form of cancer. With the latter form of disease the surrounding tissues become implicated at an early period, and thus the passage may become much constricted soon after the stricture is suspected. Ulceration of the tube above or about the diseased mass will generally take place, and cavities in the cellular tissue around will be constantly found communicating with the ulcerated points of the œsophagus. Occasionally the destruction makes its way outwards, until several openings are formed externally about the neck, and allow the escape, not only of matter, but also of the fluids taken as nourishment. Or the ulcerative action may run in a different direction, burrow about the muscles of the neck, or effect a fistulous communication with the trachea. The latter condition is made evident by fluids, taken through the mouth, being coughed up through the glottis.

In other instances, almost instantaneous death will occur from sudden and violent hæmorrhage, dependent on the ulceration of a large artery.[1]

The symptoms of stricture of the œsophagus are so marked, that it might at first sight appear almost impossible to be deceived regarding its occurrence. But an hysterical spasmodic condition of the pharynx or œsophagus is occasionally met with and might be mistaken for organic mischief, without some precaution and judgment brought to bear on the case. It is therefore prudent to weigh carefully the symptoms of all cases of supposed stricture of the œsophagus, in order to be able to discriminate between actual stricture, and that of nervous origin. The latter disorder is not very commonly met with; but it will be found, as a rule, to occur in women. In two instances familiar to us, the symptoms were evidently entirely due to the state of health, and yielded effectually to constitutional treatment. The symptom which commonly distinguishes an hysterical or spasmodic difficulty in swallowing from a real stricture is the easy manner in which a patient can swallow fluids, or even solids, when allowed to take them apparently unobserved. There is little, if any, emaciation; nor is there the early indication of loss of strength, nor the constant desire for food if it could only be swallowed.

Although the existence of a stricture itself may be generally ascertained without difficulty, the cause of the obstruction is not always so satisfactorily detected. The chest should always be carefully examined, with a view to satisfy oneself that neither aneurism nor any other mass was pressing on trachea or œsophagus. This having been done with the conviction that no external pressure was the cause of the impediment to the passage of food, a very careful and very gentle examination may be made with a gum catheter or small œsophageal tube. If this can be passed with but the very slightest pressure, it may reveal the fact that the obstruction is due to some simple cause of contraction, and is not one of a cancerous nature.

The author was consulted by a lady, about thirty-eight years of age, who had for some weeks experienced an increasing difficulty in swallowing solid food, and could take little else than fluid nourishment, and this only with care and in small quantity at a time. There was no history of any injury from having swallowed any acrid or caustic fluid, bone, or other substance to cause abrasion, or give rise to ulceration. There was no pus or offensive odour in the fluid rejected after attempts to swallow nourishment. A thin œsophageal tube was introduced, and very gently passed till it reached an obstruction, some eight or ten inches down the œsophagus. After

[1] A case is recorded in the *Transactions of the Pathological Society* (vol. ix. p. 194) of death by hæmorrhage from ulceration extending from the œsophagus to the right subclavian artery. And a second instance is found at page 202 of the same volume, in which death was the result of perforation of the superior intercostal, by extension of ulceration from the cancerous stricture. The vertebral artery has been known to be perforated under similar conditions.

waiting a short time, the tube was passed through the obstruction and readily reached the stomach. The patient soon learned to use the instrument herself, and in a short time was able to pass one the diameter of a No. 18 catheter. She has continued to use this tube daily three or four times ever since, and to feed herself through it. Her health has continued good. In order to economise time and save trouble, a long flexible rubber tube was attached by one end to the œsophageal tube, and by the other to a vessel capable of holding about a pint and half of fluid. This vessel was each time filled with milk, mixed with eggs, flour, strong soup, or wine, and was then fixed about a foot above the patient's head. The tube having been introduced into the stomach, a tap attached to the vessel is turned, and the contents of the latter flow into the stomach. A similar apparatus was supplied to a patient in St. George's Hospital, who was admitted under the care of the author for difficulty in swallowing, the result apparently of some obstruction of the œsophagus dependent on simple contraction. Similar treatment may be followed in all cases in which the obstruction is due to cicatrix or other non-malignant causes.

If, however, there is much difficulty in swallowing, much emaciation, offensive fluid, mixed with pus, or occasionally blood, rejected with the food attempted to be swallowed, the conclusion to be arrived at will certainly be that the stricture is of a cancerous nature, and in most cases such a conclusion will not prove wrong. The use of a tube of any kind must in such a case be only attempted with the greatest care and gentleness; rather as a means to confirm one's opinion than with any prospect of benefit to the patient. If the slightest obstruction is met with, the tube had better be withdrawn at once. Any pressure may readily cause mischief, by causing the tube to pass into the mediastinum or pleura, or even pericardium.

When a pouch of the pharynx or œsophagus exists, it may be suspected, if, after partaking of food, the patient feels any fulness in the neck, or if, after a time, a portion of the meal is returned. As the pouch is capable of holding a certain quantity, there is not so much difficulty in disposing of a portion of solid food as in stricture; for a part may pass into the œsophagus, and the rest into the pouch. A patient suffering from a pouchy condition of the tube does not emaciate as rapidly as one affected by stricture; several instances on record are stated to have lived to a good old age.

The treatment of hysterical contractions of the œsophagus should be constitutional rather than local: though the introduction of the tube in the first instance may occasionally be desirable, to confirm the opinion that no permanent obstacle exists to prevent the patient taking food. Such cases usually yield to proper treatment without much difficulty, though occasionally in young women some little patience and skill are required to remedy the disordered state which gives rise to this nervous affection. Seldom, however, do we find patients of this class deprive themselves of food to such an extent as to cause emaciation.

When the stricture is proved to be permanent, whether the result of cancerous or cicatricial contraction, and death by starvation is the probable sequence, the operation of gastrostomy is one alternative by which the surgeon may attempt to prolong life, and so far mitigate the sufferings of the patient. This operation has been frequently had recourse to, with results which in a few cases may be considered somewhat satisfactory.

More recently, however, the operation of opening the œsophagus in the lower part of the neck and below the seat of stricture, to enable food to be introduced through the opening into the stomach, has been advocated, and adopted in a few instances. The subject is one of considerable practical interest. At present, however, our experience is not sufficient to justify any decided rule to be laid down as to which operation should be generally selected as least dangerous or most efficacious. In the majority of cases we have to deal with a disease which sooner or later will prove fatal; it is, therefore, practically a choice of the lesser evil. In the large majority of cases the seat of stricture may to a certain extent be pretty accurately defined; not so, however, the extent of the disease beyond its commencement. If the stricture, as often occurs, be situated high up, œsophagotomy may be fairly adopted

with good prospect of reaching a healthy portion of œsophagus below the seat of contraction; but when the obstruction is known or suspected to be lower down, there can be but the alternative of gastrostomy.

Mr. Reeves, in an interesting and able communication to the Clinical Society,[1] last year drew attention to this subject. After narrating the particulars of two cases of malignant stricture of the œsophagus, in which gastrostomy was performed, he pointed out that, having thus operated in deference to the opinion of his colleagues, he should proceed to open the œsophagus in any suitable case of stricture of that organ in preference to opening the stomach. He observed that recent investigation proved that malignant obstruction was most commonly situated in the upper part of the tube, and a larger number of observations were needed to enable us to arrive at any correct conclusions, still there was sufficient justification for the rules he wished to lay down: viz. '1. That because of the great mortality of gastrostomy, and also because of the more frequent occurrence of malignant stricture in the upper portion of the tube, œsophagostomy is by far the preferable operation. 2. That even in cases in which the stricture is as low down as the manubrium sterni (its depth rarely being very great), œsophagostomy is indicated as a preliminary or exploratory operation, and if it be found that the little finger or sound cannot be got through the stricture, gastrostomy may be performed. 3. That if it result that the opening in the œsophagus have been made below the stricture, as in most cases would be desired, the operation can be completed by stitching the mucous membrane to the wound-edges, and the stricture may, if thought proper, be dilated through the opening, either at the time of the operation or subsequently. 4. That if the diseased œsophagus be reached, and no opening into it can be made through healthy walls, then it may be carefully perforated, either by the finger or the thermo cautery. 5. Œsophagotomy has been many times done, and œsophagostomy several times, and never have these operations caused any grave local or general symptoms, or as operations led to the death of the patient, whereas gastrostomy has proved most fatal.' 6. The operation should be done on the left side of the neck, and a sound should, if possible, be passed—that of Vacca Berlinghiéri being the best. The skin incision should be rather nearer the middle line than that for ligature of the common carotid, and should extend from half an inch above the episternal notch to the level of the upper border of the thyroid cartilage. The surgeon should stand on the left of the patient, looking obliquely down and across the body. A tube with a funnel-shaped end should be passed and tied in place, and nourishment administered as soon as tendency to vomit has passed off. It is necessary to make the opening in the walls of the œsophagus with a sharpish stab, to prevent the loose mucous membrane being pushed before the knife. The edges of the wound may be stitched up and care taken that no food gets into it. 7. The operation should be undertaken 'before the patient's strength is much exhausted, and even before obstruction is complete, because frequently attempts to swallow produce spasmodic suffocative dyspnœa. 8. In a severe case of fibrous or syphilitic stricture in the nuchal or upper thoracic portion of the tube, œsophagostomy is indicated, as then the operation might be curative as well as palliative.'

Mr. Reeves is reported[2] to have operated on a man at sixty, on account of malignant obstruction of the œsophagus. Œsophagostomy was undertaken and successfully completed. It was difficult to recognise the œsophagus. The case is still under treatment.

Mr. Holmes,[3] Surgeon to St. George's Hospital, has also reported a case in which he opened the œsophagus in a case of stricture complicated with an enlarged gland or growth in the upper and left side of the neck, and in which the obstruction appeared to be about the upper border of the thyroid cartilage. Mr. Holmes succeeded in opening the œsophagus through healthy tissues and below the seat of stricture. Very little blood was lost in the operation, but the patient, already much reduced and emaciated, gradually sank and died about three days after the operation. Post-mortem examination showed that 'the opening had been made about an inch below

[1] *Lancet*, Nov. 5, 1881, p. 796. [2] *Ibid.* July 15, 1882, p. 75.
[3] *Medical Times and Gazette*, July 29, 1882, p. 117.

the lower edge of the thyroid body, and the recurrent nerve lay quite close to it, almost in contact with one of the ligatures passed through its lip; but had not been touched or injured in any way. The main tumour occupied the site of the right great cornu of the hyoid bone, which seemed lost in its substance. It was adherent to the thyroid cartilage also. In structure it resembled epithelioma to the naked eye, but there has not yet been any opportunity for microscopical examination. The thyroid body, which was very large, was infiltrated in its deeper portions with a similar whitish deposit, and they had implicated the coats of the œsophagus, so as to produce considerable constriction. On passing the end of the little finger down, it felt at first as if the food tube was closed; but by steady pressure the finger could be pushed through it.' The seat of the stricture was just behind the thyroid cartilage.

Mr. Durham has made a happy suggestion in advocating the use of a flexible bougie, to be retained for some short time in the œsophagus in some forms of stricture. We have already alluded to a case under our own observation, in which the daily use of a catheter has been followed by great amelioration to health, and great comfort to the patient, and has now been uninterruptedly in use some five years. Such, however, could only have been the result in a simple, not a cancerous, stricture.

As already stated, so it will be found in practice, that when, with severe stricture, maintenance of life depends on a small quantity of fluid food, loss of flesh and general deterioration become so rapid and complete, that a patient will die much sooner than may often be anticipated, with all his faculties clear to the end.

Under such circumstances any operation may even prove too late. The patient may be too much reduced to be able to rally after its performance; or too much exhausted to benefit by the food supplied through the artificial opening; or even it may be that in such a reduced condition sufficiently healthy lymph may not be thrown out so as to secure such adhesion of the opposed surfaces of stomach and external wound as is requisite for the success of the operation. In a case recently under the notice of the author, such a result followed the operation; and when the sutures were removed, the adhesions were not sufficiently organised to maintain the parts in apposition.

George Pollock.

DISEASES OF THE TONGUE.

IN a description of the surgical diseases of the tongue and their treatment such as the present, which must necessarily be short, all minute consideration of the anatomy of the organ will be omitted. It is only needful to remark here that any and all of the structures of which it is made up, whether mucous membrane, muscle, glands, ducts, blood-vessels, lymphatics, or nerves, may be the seat of morbid changes, and are so in different cases. But perhaps the best general order in which to consider the latter will not be primarily an anatomical one, but rather clinical, at all events for the present. The matter in hand, then, will be divided into four sections, as follows. In the first, the *congenital faults* will be considered; in the second, those conditions of the tongue requiring surgical interference which are the *result of inflammatory change*; thirdly, those which are due to the presence of *neoplasms*; lastly, we shall study the *operations* necessary for the removal of the whole or portions of the tongue.

It may be noted here that in infancy and childhood there are comparatively few morbid conditions of the tongue which claim the particular attention of the surgeon; in early adult life, however, their number rises, but it is in middle and advanced age that the most important affections are met with.

Congenital Faults.

In the tongue congenital defects are rare as compared with other parts of the body. The first for which we would look almost naturally is *deficiency of development* in the form of absence of the organ; but of this, after long search, I can only find one instance. This was recorded by Jussieu [1] more than 160 years ago. In his interesting memoir, which is well worth reading, he describes the case as one of a girl of fifteen years, who from the time of her birth showed no evidence of the development of a tongue, the floor of the mouth being flat, except for the presence of two small papillæ which moved freely. She appeared to be little, if at all, inconvenienced by this condition, and could speak well. The fact that none of the best known writers on malformation since then, whom I have consulted carefully, from Geoffroy de St.-Hilaire [2] to von Ammon,[3] Förster,[4] or more recently Ahlfeld,[5] have been able to add other similar cases to this one, says much for the extreme rarity of the defect.

But the tongue may be otherwise malformed at birth in the direction of deficiency, though still very rarely. Thus it may be cleft vertically, either in the middle, or here and on both sides, forming in the first place a bifid, in the second a three-lobed organ, as figured in Ahlfeld's atlas (*loc. cit.*) In such cases the surgeon might be called upon to freshen the edges of the clefts with the knife, and bring them together with sutures as in hare-lip.

Horizontal clefts are not known, though congenital fleshy tumours under the organ have been mistaken for a second tongue (von Ammon, *loc. cit.*)

Shortness of the *frænum linguæ*, to an extent embarrassing to the tongue, is sometimes met with, though far less frequent and important than is commonly sup-

[1] Jussieu, *Hist. de l'Acad. Roy. de Science*, 1718; p. 6 of *Mémoires*.
[2] *Des Monstr. Humaines*, 1822.
[3] *Die angeb. chir. Krank. d. Mensch.* 1842.
[4] *Missbild. des Mensch.* 1861, p. 100.
[5] *Ibid.* 1880.

posed. This 'tongue-tie' is, so to speak, the dread of young mothers, who fancy that if it exist their child will later on be unable to talk. But instances where it has interfered with speech must be exceedingly rare, if they ever occur, for we know that even complete absence of the organ from birth, as in Jussieu's case, is compatible with excellent powers in this respect. And even where the whole tongue has been lost later by disease, the same has been noticed and recorded by Roland [1] and Louis,[2] quoting Scotchmore's (1743), Bonami's (1763), and Aurran's (1766) cases. All these records will be read with much interest, especially that by Roland, though for lack of space they can only be briefly alluded to here.

But even if this condition exist to some extent, it is questionable whether in most instances without division the movements of the tongue do not sufficiently stretch the frænum before very long. In some few cases, however, it does appear not only shorter than usual, but tougher and less inclined to stretch, and in this state to interfere with sucking by preventing the proper application of the tongue against the palate. Then, and only then, does it call for surgical interference. This will consist in division of the band, either by knife or by scissors. If the first of these be used, the band should be transfixed and cut outwards with a curved blade. But whichever of these instruments is used, a very limited incision in the frænum should be made as close to the jaw as possible, in order to avoid both the ranine veins and arteries, severe and even fatal hæmorrhage having resulted in some cases from wound of these vessels in the infant, favoured by the efforts of sucking. To another danger from this operation attention has been drawn by Petit,[3] and illustrated by three cases from his own practice. If the frænum and subjacent muscle fibres be too freely divided, energetic sucking on the part of a hungry child may tear the wound of these very lax tissues further and further open, until the tongue, having lost all its anterior support, turns over into the pharynx, and is firmly embraced by the muscles of deglutition, which force it down upon the epiglottis, and the latter upon the larynx, until suffocation is produced. The mechanism of this displacement is so important, as bearing upon other operations in later life, that a brief notice of these cases, as described by Petit, may be useful here.

The *first* was that of a child whose frænum had been divided shortly after birth, and who died five hours later of suffocation. Struck with the peculiar train of symptoms, he carefully examined the mouth by dividing the cheeks as far as the masseter muscles. He then found that the tongue was turned over, so that it had become engaged behind the soft palate, its dorsum resting against the posterior wall of the pharynx, and pressing the epiglottis firmly down upon the larynx at the same time.

The *second* case was precisely similar, suffocation setting in shortly after division of the frænum two hours after birth. Here Petit found the tongue in the same position as in Case 1, but was able to replace it with his fingers. Five minutes later the same symptoms recurred, and the tongue was found to have retroverted as before. Eventually, after repeated attacks of the same kind had been watched, he succeeded in keeping the organ permanently in its proper position with a compress. During the following night a careless nurse neglected to replace this compress after feeding the child; the same respiratory difficulty set in, and before Petit could be called in the patient had died suffocated. The tongue was found in this case to lie as in the first.

His *third* experience was precisely similar, but being this time on his guard, the tongue was regularly replaced and effectually retained in position for several days, until all tendency to retroversion was gone, the child recovering completely.

Another effect of deficiency of development involving danger has also been noticed here—namely, the very opposite condition to 'tongue-tie.' The frænum has been either so very long and lax or so completely absent that the tongue has been able to turn over into the pharynx precisely as described above after operation, and thus to cause suffoca-

[1] *Aglossostomatie*, 1630. [2] *Mém. d. l'Acad. Roy. de Chir.* tome xiv. p. 364.
[3] *Hist. de l'Acad. Roy. de Science*, 1742; p. 247 of *Mémoires*.

tion. One such case is minutely described by Petit (*loc. cit.*), in which the child had to be closely watched for three weeks, and its tongue repeatedly replaced before it could be left to itself, and had ceased to produce these attacks of suffocation. Two similar cases are recorded by Fairbairn.[1] One, combined with smallness of the lower jaw, was fatal from suffocation; the other, under due care of the mouth, recovered, and was five years old at the date of the report.

Again, the tongue may be present as far as its muscular elements are concerned, but have failed to rise from the floor of the mouth in the usual course of development (see von Ammon, *loc. cit.*) In this condition it gives the impression of being tied down all round the border, and that, if freed here, it would rise to its normal position. Such a view is, however, erroneous. We are probably dealing here with an arrest of development, at a stage in which the tongue does not project upwards into the mouth, and not with any fault in the mucous membrane on the floor of the latter. To divide this, then, would not enable the tongue to rise any more than before, unless development set in once more. Such an error might be serious, as such a free dissection round the floor of the mouth would be a grave operation.

Adhesions have, however, been found at birth around the borders of the tongue, as the result probably of intrauterine inflammation, and have been relieved by simple division of the bands, as in the cases quoted by Clarke[2] from Sernin and Maurin. Such a condition is, however, as rare as the last, with which it should not be confounded, for here operation is as urgently called for as it is unjustifiable in the case of the congenital arrest of development. A careful examination of the organ will leave little open for a mistake of the kind.

Excess of development is rarely met with in the tongue, as affecting the whole organ, unless we regard the condition known as macroglossia as such (see below). But cases are spoken of by Fournier,[3] in which the latter was much longer and extensile than usual, even to the extent of touching the chest with its tip, the head being held erect and the neck being of the usual length.

On the other hand, one or other of the tissues of which the organ is made up may be overdeveloped as a whole or in part, and thus produce enlargement, partial or general. Thus the veins of the tongue have been found engorged at birth as a consequence of a twist in the umbilical cord during intrauterine life, and this condition has taken some days to subside, so long had it existed and so dilated the vessels. Again nævoid dilatations of the veins of the tongue are occasionally met with at birth, as well as hypertrophy of the lymphatic structures, giving rise to the condition known as 'macroglossia.' But, besides these, a variety of tumours may be formed here, in utero, as the result of hypertrophy of part of one of the lingual structures. Thus we find fibromata, lipomata, papillomata, racemose adenomata, as well as dilatation of glands forming ranulæ, and even sebaceous cysts. The nature and treatment of all these will be discussed more at length further on in the section on 'Tumours of the Tongue,' whether congenital or acquired.

Macroglossia.

As holding an intermediate position between the congenital and inflammatory conditions, we turn now to that disease known, since the days of Galen, under a variety of names, as *macroglossia*, *lingua vitulina*, or *propendula*, *procidentia* or *prolapsus linguæ*.

It is only within recent years that the affection has become the subject of careful clinical and histological research. Weber, whose exhaustive article in 'Pitha and Billroth's Handb. d. Chir.' may be referred to for the older references on the subject, was himself one of the first to describe the morbid histology of the condition.[4] He was immediately followed by Virchow,[5] who first really put its nature in a clear light. The latter was then followed by many other observers, among whom may

[1] *Med. Times*, vol. xii. p. 392. [2] *Diseases of the Tongue*, 1873, pp. 42, 43.
[3] Quoted by Clarke, *Diseases of Tongue*, p. 44. [4] *Virchow's Archiv*, 1854, p. 115.
[5] *Ibid.* p. 126; also *Krankh. Geschwülste*, Bd. iii. pp. 101, 293.

be specially mentioned Arnstein,[1] Billroth,[2] Humphry,[3] Arnott,[4] Maas,[5] and quite recently by Wagner,[6] all confirming his views, amplifying them somewhat, but not adding much to his main facts. The subjoined brief description then of the disease is chiefly based upon a careful examination of these more recent writings on the subject (the author's personal clinical observation extending only to two cases, in only one of which there was an opportunity of microscopic examination of the organ), the conclusions being drawn from a consideration of the whole mass of evidence before us.

The condition in question is characterised by an overgrowth of the tongue of greater or less rapidity, and affecting all its dimensions, sometimes to an extraordinary degree. Thus it has been found to measure as much as six and a half inches in length and ten inches in circumference. It may protrude far over the chin, and even into the episternal notch. When thus enlarged, it has been found to produce great deformity of the teeth and jaws, especially the lower, in a number of cases (Siebold, Humphry, *l.c.* Hodgson[7]) Clarke,[8] Fergusson.[9] The alveolar process is pushed forward, and the lower front teeth bent over into the horizontal position, if they have not been rendered carious, and dropped out, as is usually the case where the condition has existed long. The jaw has even been known to be eventually dislocated in extreme cases (Chalk[10]).

When thus swollen, the tongue is much altered in external appearance, though not so when but slightly enlarged. This is due to the accidents depending on its constant exposure to the air, the patient being unable to bring it into the mouth. The decomposition of the saliva and chafing against the teeth, &c., produce chronic irritation, and this leads to induration, fissures, and irregularities of the surface, and even to ulceration and scarring. In a case under the author's care for a time at University College Hospital, the appearances were precisely the same as those described by other observers. The uniformly hypertrophied organ looked more livid than usual; it was of a tough spongy texture, covered especially at the sides and under surfaces with small knotty semi-transparent elevations of conical or rounded shape, scattered irregularly. The enlargement was not accompanied by any pain, but was very troublesome from the flow of saliva produced by it; it was free from active congestion. When incised, it yielded very little blood, but a relatively large quantity of clear serosity. An attack of glossitis, produced by the introduction of a seton, only aggravated the condition. In another case in hospital at the present moment (June 1, 1880), under the care of one of my colleagues, the external appearance of the organ suggests little more than a general enlargement of all the elements of the organ, in its anterior two-thirds. It can be retained in the mouth, and then only causes a fulness in the floor of the latter, where, too, an extra swelling of soft consistence, and about the size of a nut, may be felt. The boy has also enlarged fingers and toes, and is semi-idiotic. The condition is congenital, and he is now nine years old. The lower incisor teeth are as yet but little deformed.

The first point, demonstrated by the study of the history of a large number of cases of macroglossia, is that the affection in the majority is clearly congenital. In Weber's[11] collection, embodying de Leuw's table of 69, and his own list of 27 cases, evidence on this point is forthcoming in a considerable number. Adding 17 cases since recorded and collected by the author, we find the following facts. The total of 113 was made up of 60 in which the disease was undoubtedly congenital; 39 in which it was apparently acquired, and 14 doubtful; 41 were males, 45 females, and of 27 there was no note on this point.

But, though the proportion of congenital to acquired cases is shown even by this table to be large, I cannot help thinking from the evidence before me that it would

[1] *Virchow's Archiv*, 1872, p. 318.
[2] *Beiträge Z. path. Histolog.* 1858, p. 215.
[3] *Trans. Med.-Chir. Soc.* vol. xxxvi. p. 853.
[4] *Trans. Path. Soc.* 1872.
[5] *Archiv f. klin. Chir.* Bd. xiii. 1871, p. 413.
[6] *Ibid.* Bd. xx. p. 641.
[7] *Trans.-Med.-Chir. Soc.* vol. xxxvi.
[8] *Diseases of Tongue*, 1873, p. 67.
[9] *System of Practical Surgery*, 5th. ed. p. 518.
[10] *Trans. Path. Soc.* vol. viii. p. 305.
[11] *Pitha-Billroth's Handb. d. Chir.*, Einband vi. p. 323.

be very much higher were all the records as minute upon this point as they should be; indeed, I have little doubt but that the affection would be shown to be congenital in all cases. For it has been noted in several instances where the child was seen shortly after birth by medical men that the tongue at that time appeared merely somewhat too large for the mouth, and projected a little against or between the teeth. Now such a condition might easily be overlooked for a long time by any but a practised observer, especially as the act of sucking appears to be of benefit for a time, owing probably to the pressure upon the tissues of the tongue by the nipple and the various movements of the organ itself. Moreover, it is also noted that not until dentition is advancing has the condition become marked in many cases. Taking this in conjunction with the fact noted, that the disease in numerous instances has *apparently* started from some violence, such as a bite during fits (to which for some unknown cause these patients appear peculiarly prone) or a fall upon the chin, as in Chalk's case, it appears not improbable that it has escaped notice in many cases in its earlier stages, and has not been recognised until the chafing of the sharp young teeth of first dentition, or a bite from them, had provoked a certain amount of glossitis, and thus aggravated the condition henceforth set down by the parents or other observers as distinctly acquired. That glossitis is one of the most prominent factors in the aggravation, if not production, of the extreme forms of the disease is clear from even a casual perusal of recorded cases. The causes for this inflammation, however, are often very slight indeed, showing by this alone that probably some congenital condition is predisposing the organ to inflame. Thus I find it starting in one case apparently from the small wound of an operation for ranula, and in others from division of the frænum (Möller,[1] Sédillot[2]), neither of which causes would have operated probably without strong predisposition. Other more marked proximate causes have been mercurialisation, scarlatinal irritation of the mouth, small-pox, and erysipelas. Once the tongue is actually permanently protruded from the mouth, a chronic glossitis is often maintained by the exposure of the organ to various forms of irritation, such as cold, the chafing of the lower incisors (which also retard the reflux of the venous blood and lymph of the part), the dribbling and decomposition of the saliva and particles of food, &c.

From all this, it will be seen that the condition has a close analogy with elephantiasis in other parts where a chronic irritation, with distension of the lymphatics, appears to lie at the root of the local change, but where a congenital enlargement of the part, probably also dependent upon abnormality of the lymphatic system, can likewise be traced in some cases. In one of the more recently recorded instances of macroglossia indeed, half the body of a child was found hypertrophied at birth, as well as the tongue; the latter also more on one side than on the other (Maas[3]); and in a case now in University College Hospital, referred to above, the fingers and toes are also enlarged on both sides. In the former case an examination of the parts removed by operation showed, however, only a simple hyperplasia of all the elements of the tongue, without a preponderance of any, except in the cases of the vessels of the papillary layer. But here the patient was only two months old, and had not as yet had any inflammatory attacks.

But the analogy with elephantiasis appears even closer when we come to examine into the histology of the part affected. Almost all who have had an opportunity of studying the affection from this point of view have described essentially the same changes. Virchow[4] was the first to notice these: namely, a remarkable infiltration of the whole organ, with innumerable white cells collected here and there within delicate networks, and forming thus a true lymphoid tissue. This was most abundant in his experience about the under surface of the organ, where it presented in parts a cavernous structure. This tissue had hardly the regularity of arrangement found in that of the lymphatic glands; but the same delicate reticulum containing lymph spaces were observed. The small semi-transparent elevations on the surface of the

[1] *Deutsche Klinik*, 1851, No. 26.
[2] Sédillot, *Gaz. des Hôp.* 1854, p. 102.
[3] *Archiv f. klin. Chir.* Bd. xiii. p. 413.
[4] *Krankh. Geschwülste*, Bd. iii. pp. 101, 293; also *Virchow's Archiv*, 1854, p. 123.

organ described above were due to the latter, which in many cases consisted of channels with saccular dilatations. The connective tissue, too, throughout the tongue was everywhere greatly increased in amount, especially immediately underneath the mucous membrane.

One of the most recent and careful observers of the lymphangiomata (Wegner [1]) departs, however, a little from Virchow in denying the infiltration of the hypertrophied part with lymphoid cells. The fact of his having apparently only examined early cases of the disease, little or not at all altered as yet by attacks of glossitis, suggests, however, an explanation of this difference. He also describes openings from the lymphatics into the venous radicles when the disease is well marked, and consequent entrance of blood into the lymphatic channels. In some cases (Weber, Grohe, Busch [2]) the muscle-fibres were said to have been increased in volume, but not in number : this, however, has not been confirmed by other observers. The large cavernous spaces alluded to contained clear lymph of the ordinary kind, and sometimes blood. But, beside these irregular dilated channels, the veins and arteries have been found generally enlarged in calibre, and somewhat thickened also, adding much to the spongy texture of the part. In one remarkably acute case, described by Virchow,[3] the glands under the jaw were simultaneously enlarged, and on puncture yielded several drachms of clear lymph-like fluid. Again, in a case from which drawings were taken by Whitehead,[4] not only was there congenital macroglossia, but also a dilatation of the lymphatics of the neck, to the extent of producing actual cystic lymphangiomata. It is, perhaps, also worth noting that in one case recorded by Valenta,[5] the enlargement of the tongue was associated with cystic hygroma of the neck.

The terms, then, *lymphadenoma cavernosum* (Arnstein *l. c.*), or *lymphangioma cavernosum* (Virchow), appear to be very suitable for this condition, especially as either of them will also cover Billroth's [6] views as to the changes met with, which indeed correspond in the main with Virchow's, except that he held the lymph-spaces found by the latter observer to be new formations, rather than dilatations of pre-existing vessels. This may be considered now, however, perhaps a distinction without a difference.

As to *causation*, we have already seen the influence of congenital fault followed up by attacks of glossitis. These last may probably more accurately be described as sub-acute or chronic lymphangitis, predisposed to by some obstruction to the return of the lymph towards the root of the organ, congenital and in part acquired. There seems much reason indeed to regard Billroth's view on this point of ætiology as most probable : namely, that the attacks which have led to successive enlargements of the organ have been caused by a thrombotic change in the dilated lymphatics of the part, with consequent swelling of the distal portion ; and that the predisposition is given, at all events in part, by the inherited scrofulous diathesis. This view gains some support from the fact that many of the attacks spoken of in these cases as glossitis are in reality far less acute than that disease usually is, and further, that in some cases (Möller's, Billroth's) after removal of the diseased portion of the tongue had been followed by recurrence of the swelling, the use of cod-liver oil, iodine, and preparations of iron, alone or in combination with other anti-strumous remedies, has been quite adequate to the treatment of the affection, the organ returning to its normal size, just as a strumous gland will do. But our present clearer knowledge of the nature of the disease, and wider experience of its usual course, teach us that we cannot expect this always to be the case. Anti-strumous remedies may retard, perhaps arrest, the advance of the condition for a time ; soothing and detergent solutions may remove causes of irritation ; but the congenital derangement of the tissues, and predisposition apparently to lymph-stasis in the part, remains, whether this be due solely to proximal narrowing of the lymphatics at the root of the organ,

[1] *Arch. f. klin. Chir.* Bd. xx. p. 461.
[2] *Pitha-Billroth's Handb. der Chir.* Einband vi. p. 323. [3] *Virchow's Archiv*, 1854, p. 126.
[4] *Internat. Med. Congress*, 1881, *Catalogue of Temporary Museum*, p. 59, No. 597.
[5] *Oesterr. Jahrb. f. Pädiat.* Bd. ii. s. 35. [6] *Beiträge z. path. Histolog.* 1858, p. 215.

or this combined with occasional thrombosis in the same situation. Sooner or later the organ is almost sure to be irritated, and it usually is so at the commencement of dentition when the edges of the sharp young incisor teeth rise out of the gums. The slight congestion thus produced will lead to greater obstruction of the lymphatics, and chronic and increasing thickness is the result.

These then are the considerations which impel us in most cases to resort to operative measures for the relief of the condition. But we now know that some of the older methods ought to have been as they were, productive only of harm. Among these were, the use of setons drawn through the tongue, injection of astringent fluids. These and like measures resorted to on the mistaken belief that thus the spongy tissue of the organ could be consolidated by inflammation or coagulation, can only be productive eventually of glossitis in one form or another, and instead of effecting the purpose intended, only produce increased lymph obstruction and swelling of the whole organ. This I have seen in one case at least.

There remain, then, only two or three other methods of *treatment*. Pressure in one form or other has been long employed, and in a few instances has been found of use. Thus, where the tongue could be pushed back into the mouth, and the chin then supported by an elastic band, some benefit has followed (Teale [1]). Again, in more advanced cases the organ has been included in a tight linen bag tied back with tapes behind the head, also with improvement. Strapping with isinglass plaster has also been used. But, although in theory such treatment is rational, tending as it does to unload the engorged lymphatics and blood-vessels of the tongue, just as bandaging and pressure on a limb affected with elephantiasis would in the latter, still practically we are met by great difficulties in carrying out our treatment; and the study of such cases is not encouraging. It only strengthens the conviction now generally gaining ground: namely, that the only method of treatment adapted to the mass of these cases is excision of the bulk of the hypertrophied organ. But there is one point in connection with this question that should never be forgotten: namely, that for this operation to be quite safe it should be performed before the tongue has enlarged inordinately, or to such an extent as to leave a large wound in the mouth after incision, with all its peculiar dangers of septic infection, to which allusion will be made later on, in considering the various modes of removing the whole or parts of the tongue (p. 599).

While awaiting the proper time for excision (for this should not be done while the child is very young, or indeed until the condition shows unmistakable signs of steady growth), it is well to suckle the infant from a large teat, so as to produce all the pressure possible upon the organ. This may retard its growth somewhat for a time, and so enable us to postpone a serious operation until an age better suited to bear it. When dentition introduces new factors of irritation, it is not judicious to defer interference any longer in most cases. The deformation of the jaw may then be prevented from taking place. If, however, a case is brought to us in which this has been allowed to take place to a moderate extent only, we may, after removal of the tongue, benefit the deformity to a large extent by exerting upward pressure on the chin by means of an elastic band passed under it and then fastened over the vertex. Later on when the jaw has become fully developed, it is almost vain to hope for much improvement from this treatment.

Inflammatory Affections.

1. *Superficial non-ulcerative.*—The inflammatory affections of the tongue have now to be considered. They may be classed into (1) the superficial non-ulcerative; (2) the ulcerative; (3) the parenchymatous. Any of these may be acute, sub-acute, or chronic.

Of many of the changes in the superficial layers of the lingual epithelium symptomatic of disordered states of the alimentary tract, and partaking of the nature of an irritation of the coverings of the organ of one kind or another, nothing special need be said in a surgical essay, however interesting they may be. An excellent

[1] *Trans. Med.-Chir. Soc.* vol. xxxvi. 1853.

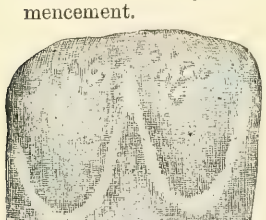
description of them will be found in a lecture delivered by Dr. G. V. Poore at University College Hospital and published in the 'Lancet' of 1880.

Nor is it necessary to enter into a description of conditions due to the presence of the parasites known as the *oidium albicans* and *leptothrix buccalis*. These are fully dealt with in medical books, and need not occupy us. That the mouth is infested with numerous lower organisms in certain conditions is well known, but it is not always as clear what the relation of these to the morbid state is, as in the case of the parasites just alluded to. Thus spores indistinguishable from those of the *trichophyton tonsurans* have been found on the tongue without any evidence of disease. Also numerous forms of micrococci in great abundance. The study of these offers a large field for future investigation. On the other hand, the presence af certain cryptogams has appeared in given cases very suspiciously associated with unusual conditions of the surface of the tongue. For instance, the *trichophyton* has been found together with a peculiar 'villous change' on the epithelial covering of the organ (Clarke). This parasite has even been present in cases where a peculiar circular wandering rash had made its appearance on the tongue deceptively like 'ringworm,' and yet probably without any causal relation to it, so far as we know. This latter condition is so apt to be mistaken on the one hand for a parasitic disease, and on the other for some syphilitic affection, that we may perhaps with advantage direct the attention of surgeons briefly to its peculiarities as far as they are known at present.

These circular wandering rashes have attracted a good deal of attention lately, not only owing to their very striking characters and their resemblance to *tinea tonsurans*, but equally on account of the discomforts associated with them.

The author's interest in them is peculiar, having been greatly puzzled in their diagnosis some years ago, and in finding then that they had not been specially described before in this country. Referring to a paper on his first two cases read at the Path. Soc. Nov. 1879 (vol. xxxi. p. 353 of 'Transactions') for details, a short account of the disease may be given here. It may be added that a few months after this paper was made public, some independent observations were recorded by M. Vanlair[1] in France on the same disease, and, later still, by Professor Caspari[2] in Germany, also independently. These three essays, with a short incidental notice by Gubler,[3] recording 11 cases in all, appear to constitute the whole special literature of the subject hitherto.

Fig. 132 represents the *Annulus migrans* in its well-developed form, as well as at its very commencement.



Above on the dorsum of the tongue are seen the two crescentic bands of rash spreading centrifugally, and leaving a smooth somewhat darker surface behind. Below are two spots at which the affection is starting afresh, soon to develop either into rings or crescentic bands travelling with great rapidity.

This affection, for which the name *annulus migrans* or *errans* was suggested by the author (*l. c.*) as sufficiently descriptive, while involving no theory in regard to its ætiology, and therefore perhaps preferable to that of 'lichenoid of the tongue,' used by Gubler, is characterised by the appearance on the tongue of small circlets or crescentic bands of light-coloured rash. These enlarge rapidly and wander from place to place centrifugally over the dorsum and occasionally the borders and under surface of the organ. Its close resemblance to *tinea circinata* is the first point which strikes the observer (fig. 132), the extreme rapidity of its movements the next, the remarkable amount of salivation accompanying it the next, and, finally, its stubborn resistance to all local or general remedies. Commencing as a small round spot of a whitish or greyish-yellow colour, it rapidly develops into a more or less complete circle or crescent (see fig. 132), of granular appearance, abruptly marked off on its convex margin from the healthy surrounding surface. That portion of the dorsum lying within the concave margin

[1] *Revue Mens. d. Med. et de Chir.* Jan. 1880.
[2] *Vierteljahressch. f. Dermatol. u. Syph.* 1880, Heft ii. and iii.
[3] *Dict. encyclop. des Scien. méd.* t. x. 1re partie, p. 234.

of the narrow band of rash, *i.e.* that last travelled over, is smoother and of a livid pink colour, but shows no trace of excoriation or ulceration, and frequently recovers its normal appearance in the course of a few hours. No pain accompanies the disease, but sometimes a little smarting in the use of particular kinds of food is noticed. In one of the author's cases intense itching and salivation lasting for months were noticed, in the others both symptoms were present in a minor degree. Of the 11 cases recorded, 5 were males, 6 females; 9 were under 20 years of age, 7 under 10 years, 1 was 66; in 4 the father had been clearly syphilitic, in 4 clearly no syphilis appeared in the family history, in 3 no record is given on this point.

Ætiology.—The first point which has occurred to all observers as to its causation has been its probable parasitic origin. Up to the present no post-mortem specimens have been obtained, scrapings of the diseased patches alone having been available for study. Careful microscopic examination of these has convinced the author that it has no relation to 'ringworm.' On one occasion certainly he found cryptogamic organisms in abundance, indistinguishable either by himself or Mr. Hutchinson, to whom he showed them, from the *trichophyton tonsurans*. But these were only met with on one occasion out of a great many observations and were most probably accidental. The same may be said of large aggregations of micrococci and other organisms observed, which were also seen by the author and by M. Vanlair, and were figured by the latter, who with Caspari takes the same view of the non-parasitic nature of the affection. Both these observers are also in accord with the author as to the independence of the disease on syphilis. No local irritation was present in any case or intestinal irritant proved. It appears nevertheless, comparing it with similar appearances, to be probably one of those degenerative changes of the superficial layers of the epithelium brought about by nerve influence, the result of reflex irritation somewhere at a distance. This is a point which can only be determined, however, by further and closer study, and it appears better for the present to adopt some name for the condition generally descriptive, but not involving any theory as to its ætiology.

Treatment.—No treatment has as yet produced any effect on the cases recorded. In my own, tonics, cod-liver oil, iron, arsenic, local applications of nit. of silver, chlor. potass, &c., were all given a prolonged trial, but without the slightest effect.

Prognosis.—Beyond being very chronic there appears to be nothing to fear from the affection but the discomfort and itching described; no other dangerous sequelæ having ever been noticed, even where the affection has lasted for years, as in one of the author's cases which he has followed up to the present.

From these irritative conditions of the most superficial layers of the epithelial coverings of the tongue we turn now to the more distinct inflammatory.

Acute superficial non-ulcerative glossitis is not a common affection. When met with it is usually the result of scalds, burns, or the application of some very irritating substance to the surface of the tongue. The latter in such a case will appear in the first instance flecked with whitish patches on a red ground. These white patches correspond to areas of epithelium which are being shed off from the inflamed surface. The latter, then, will have soon lost large tracts of its covering and will appear glazed and reddened, with prominent papillæ, and will be very sensitive, owing to the greater or less exposure of the latter without their usual covering.

The *treatment* will consist in restricting the patient to fluid food of an unirritating kind and giving him ice to suck. The condition, if it have gone no further than above described, has a tendency to get well rapidly of itself, and beyond the treatment indicated requires little.

Sub-acute and *chronic superficial glossitis* of the non-ulcerating form are, however, by no means uncommon, and constitute an important class of diseases.

The causes here are usually external in the form of local irritation of one kind or another. This may be due to the constant over-stimulation of the surface of the tongue by too hot food, the excessive use of spices, the abuse of ardent alcoholic fluids, the chafing of teeth roughened either by decay or a coating of foul tartar, the play of the tongue against ill-fitting false teeth, finally, by the over-use of tobacco, either chewed or smoked. There is reason to think, however, from the study of

certain recorded cases that somewhat similar, if not identical, conditions can be produced, or at least strongly predisposed to, by causes operating from within at a distance, such as irritation of the gastro-intestinal tract from varieties of indigestion, or, possibly the presence of parasites, such as tapeworm (Möller *l. c.*).

The appearances presented in the earlier stages of *sub-acute* superficial glossitis produced in any of these ways will usually be as follows :—There will usually be congestion of the surface of the tongue over a larger or smaller area, on which the papillæ will be prominent and excessively sensitive. Or, a little later, the irritated patch may be covered with vesicles or desquamating whitish epithelium which, on being respectively ruptured or shed, leave an inflamed raw or glazed base, also acutely sensitive. This condition has a natural tendency to rapid recovery if the cause be removed, owing to the highly organised structure of the tongue. It is only necessary, then, for its treatment to find out the local irritant and remove it, and at the same time to keep the tongue cleansed for a while. If the cause be suspected to lie in the gastro-intestinal tract, attention to the diet, with the use of alteratives, antacids, and laxatives will usually be found to benefit.

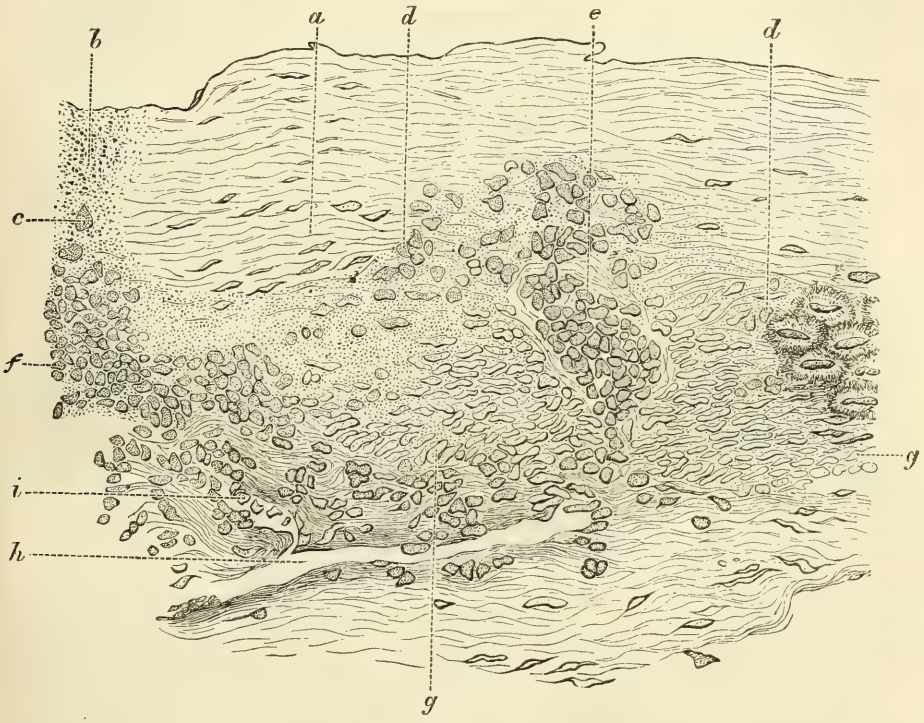
In the more *chronic* forms of superficial glossitis, due to one or other of the causes mentioned above operating over extended periods, peculiar permanent changes take place in the epithelial covering of the tongue in many instances which deserve particular study. In the first place, slightly raised, glazed, and reddish patches are developed on one or other part of the organ, most usually the dorsum. These are due simply to a localised hyperæmia of the papillary layer of the tongue. As a consequence of the prolonged existence of this increased vascularity, the epithelium sooner or later becomes thickened, its most superficial layers furthest from the blood supply undergoing keratinous changes. In this way patches of hypertrophied and now whitened epithelium soon more or less obscure the colour of the vascular patches over which they are formed. These plaques generally attain a considerable size before being noticed by the patient, for they are not painful, do not affect the sense of taste, and only in some advanced cases are accompanied by increased flow of saliva, nor are the glands under the jaw in any way affected by the condition in uncomplicated cases.

Much attention has been given to this condition in its various stages of late years, and it has been described from time to time under many names—*e.g. plaques opalines*, *plaques des fumeurs*, *psoriasis linguæ*, *ichthyosis glossæ*, *keratosis*, *tylosis*, *leucoma*, and *leucoplakia*. These are only mentioned here for the purpose of adding that they all mean the same condition, and that this is initiated by a chronic superficial glossitis as above briefly described. The last name applied to the affection will recommend itself to many in this country who would willingly avoid the fallacy of implying its analogy with other fully investigated skin affections by the use of a name borrowed from dermatology, or dislike the use of a word indicating a supposed special cause. This word *leucoplakia* is suggested by Schwimmer,[1] who in the most exhaustive and interesting description of the disease yet published has analysed his own numerous observations as well as those of almost all the authors who have preceded him. He has traced the disease from its first appearance in the form of slightly elevated, dark red, and smooth patches on the mucous membrane, the result of 'congestion of the deeper epithelial layers with consecutive hyperplasia of certain tracts of papillæ,' to that of the bluish-white plaques described above, and even beyond this to those ultimate degenerative changes into malignant disease which are now known to supervene sooner or later in only too many cases. For a minute and detailed description of the morbid histology of the condition the reader is referred to the essay, by Schwimmer, mentioned above, and to another by Nedopil.[2] It is only necessary to say here that the disease, *if seen early*, presents itself in the form of small hyperæmic spots of dark red colour situated on any part of the tongue, lips, palate, or cheeks, but most usually on the dorsum of the former and near the angle of the mouth in the latter. This condition, of which I have seen a particularly striking example lately, should be studied carefully with a view to early treatment. These, spreading and

[1] *Vierteljahresschr. f. Dermatol. u. Syph.* N.F. 1877, p. 511.
[2] *Archiv f. klin. Chir.* Bd. xx. 1877, p. 324.

coalescing, eventually form considerable plaques, which by this time have become of a pale bluish-white or dead-white colour. In this stage the tongue looks as though it had been brushed over certain areas with a solution of nitrate of silver; but the surface is here still soft and even. Now as long as there is a narrow border of erythema around these white patches they may be regarded as on the increase; if this is absent, active growth has come to a standstill. Later on, then, the plaques may become greyish-white or sometimes yellowish, and their surface marked by intersecting depressed lines. The presence of the latter is due to the hardening of the epithelial covering of the tongue, which has now taken place, destroying its general pliancy, and necessitating a wrinkling with every movement of the organ. In some very advanced cases the epithelium may become so hardened as actually to

FIG. 133.—A part of the Plaque under a higher power. (Object 9 immersion: camera lucida.)



a, thickened keratinous layer of a highly developed part of a plaque; *b*, keratinous layer above small-celled granulation with some bright bodies (*c*); *d*, granulation-cells advancing into the epithelium from the neighbourhood of a markedly proliferating papilla (*e*); *f*, lateral boundary of the small-celled granulation (exudation); *g*, inferior boundary of the epithelium, whose cells are partly thrust asunder by exudation springing up from the mucous layer; on the right (of the figure) they are flattened; on the left destroyed by the fine-celled exudation; *h*, a vessel in the submucous tissue, from which on the left there springs a twig (*i*), surrounded by dense granulations, and stretching into the fine-celled exudation.

crack and split along these lines, and may then scale or be peeled off in fine layers. All such changes are due simply to different degrees of keratinous alteration of the epithelium, induced by chronic irritation modifying its vascular supply (fig. 133, 134).

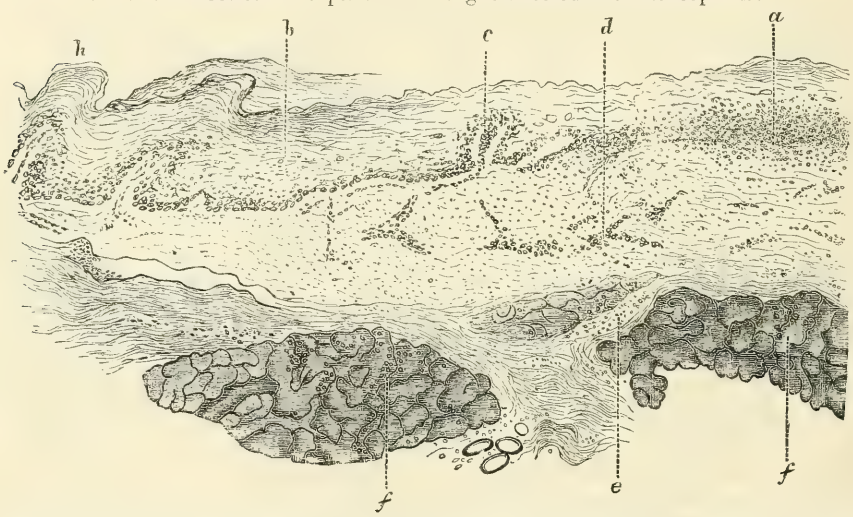
When the disease is well marked, a notable change is found to have taken place in the papillæ of the tongue, beneath the white patches, as seen under the microscope. These, which at an early stage were hypertrophied and infiltrated with leucocytes (fig. 133 *e*), are now atrophied as regards all their elements, or have wholly disappeared (fig. 134 *c*, *a*). In the layers underlying them, exudation of cells is still seen along the vessels (fig. 134 *d*), and the tissue, to put it briefly, is generally sclerosed.

Now when this condition of leucoplakia has lasted for a longer or shorter time, and the heaping up of keratinous layers of epithelium has gone on to an extreme degree, other changes in the epithelial covering are very apt to arise and to result in epitheliomatous cancer. Briefly, the cells of the deeper layers commence to

proliferate more rapidly than usual, spread downwards into the substance of the tongue in the form of rapidly enlarging lobules, until the well-known characters of epithelial cancer are clearly present. This overgrowth may or may not be preceded by slight chronic degenerative ulceration of the white patches. In those cases where cancer followed on leucoplakia seen by the author, this ulceration usually preceded the malignant degeneration, and the latter appeared on the whole rather slower in its advance towards infiltration of the surrounding structures and glands than epithelioma starting in other ways (see p. 592).

When all this malignant change is about to take place, or whether it is going to begin at all in any given case, are points which cannot be determined positively as yet from any known premonitory signs. It can only be said that the condition is always a suspicious one, and to be regarded with anxiety whenever it exists, especially if it be accompanied by ulceration. The latter complication, indeed, must be looked upon as constituting the affection a most grave one, which should be dealt with by free and early excision, if it be found that there is any induration present with it.

FIG. 134.—Section of a portion of Tongue affected with Leucoplakia.



a, small-celled granulation representing the exudation at the boundary line of the epithelium; *b*, thickened epithelium of the plaque proper; *c*, cell-proliferation in the papilla body most evident at the tip. To the right of *c* for a considerable way all the papilla bodies of the mucous layer are seen to have been destroyed; *d*, vessel in the corium around which for the most part the small-celled infiltration has taken place; *e*, granulation-cells in the corium; *f*, mucous glands with proliferation in parts; *h*, relatively normal epithelium, with perfectly sound papillæ.

This disease, frequently noticed during the last fifty years, was supposed by its earlier observers to be the result of syphilis (Babington Wallace). Other writers described it as connected with or part of a general ichthyosis, only most marked on the skin (Plumbe,[1] Alibert,[2] Rayer[2]). Later on it was recognised by Buzenet[3] and Ullmann in 1858 as a condition independent of skin affections and of syphilis, and as probably produced by smoking, and was named by the first of these writers 'plaques des fumeurs.' But the chief interest of the affection dates from the observation of the fact by Mr. Hulke[4] in 1861 that it may be the starting-point of epithelioma, if not its sure precursor, as already mentioned. The conclusion that this is so was also arrived at independently a little later in 1862 by Neligan[5] of Dublin, who published a very remarkable case of the condition and the development in it of epithelioma, with the object of drawing the attention of insurance consultants to the significance of the latter fact. From this time to the present the affection has attracted much attention, chiefly as regards the following points, viz. (1) its *causation*, *i.e.* whether due to syphilis, smoking, or other local irritations, or the same diathesis which pro-

[1] *Diseases of the Skin*, 1837. [2] Quoted by Schwimmer, *l. c.*
[3] *Le Chancre de la Bouche*, Thèse inaug. Paris, 1858.
[4] *Med. Times and Gazette*, 1861, 1864, 1873.
[5] *Dublin Quart. Journ. of Med. Science*, 1862.

duces ichthyosis or psoriasis of the skin; and (2) its *exact relation to epithelioma i.e.* whether simply predisposing to the disease or inevitably followed by it.

In studying this disease in its various stages specially for myself for some years past, I have been at much pains to collect as many cases as possible from home and foreign sources, in which these white patches have been described as found on the tongue or other parts of mucous membranes, and to tabulate them in such a manner as to afford evidence on these and other questions. This table, including several cases from my own practice, together with others recorded by the authors whose names and records on the subject are given below,[1] now offers 96 cases for study. While correcting this for press I have, through the kindness of Mr. Henry Morris, been furnished with notes of an additional 14 cases which have been under his own observation, and have much satisfaction in adding them to the above.

We have then a total of 110 cases before us for analysis. Of these 101 were males, 9 females. Among the former the affection was seated on the tongue in 55, on the tongue and cheeks in 33, on the lips and cheeks in 12, on the hard palate alone in 1, and in 4 the seat of the affection is not given. Among the females the tongue was affected in 7, the vulvæ in 1, the lips and cheeks in 1.

As to its *ætiology* the following data are afforded by the above collection of cases. In the first place its relation to *syphilis* may be considered. Distinct evidence of these patients having suffered from concomitant syphilis is forthcoming in 33 cases; it is distinctly negatived in 19, no history of it is given in 32, and no statement on this point in 19; in 1 it was probably present, and in 4 doubtful, while in 2 it was contracted after the white spots had appeared. That leucoplakia may occur quite independently of syphilis appears therefore perfectly evident from 19, if not from the additional 32 cases. These hard statistics, however, will not at present settle this matter beyond question. But the internal evidence of the cases themselves, including those I have seen, leads, when read carefully, to the conclusion that these white spots appear in patients who have never had this disease. There are, however, syphilitic affections very like that in question in its earlier stages (see p. 570).

As to the relation of *smoking* to its causation evidence is forthcoming in 75 cases. In only 4 is it distinctly stated that the patients did not smoke, in 11 that they simply 'smoked,' in 14 that they did so in moderation, and in 46 that they indulged in the habit to excess. There are then 71 smokers to 4 non-smokers. We must not forget, however, that the disease showed itself in the female in 9 cases (presumably non-smokers), and in 1 case it appeared on the vulvæ, where it developed into epithelioma within 18 months; in the remaining 8, on the tongue in 7, the lips and cheeks in 1, with cancerous change in 2. There can be no doubt, however, that, though it may arise independently of smoking, the latter habit was the proximate cause in the majority of cases hitherto observed.

As to its *relation to other skin affections*, ordinary psoriasis or eczema was a concomitant in 6 cases, syphilitic psoriasis in 2. Ichthyosis has also been seen associated with it in more than 1 case.

Besides all this, there is evidence in several of the cases before me that the affection may be produced by other irritants introduced into the mouth habitually, such as the hotter variety of spices, ardent spirits, &c., as in a case at present under my own treatment. The chafing of irregular or false teeth has also apparently been at the root of the affection in other cases.

The most important question now arises, namely, its relation to epithelioma. On this our list furnishes the following data. In 43 cases (probably in 1 more) epithelioma supervened upon the condition. Of these a family history of cancer is only given in one case. It had existed before the development of malignant disease for periods ranging in several cases from above 30 and 40 years down to 15 months,

[1] Paget, *Trans. Clin. Soc.*, 1870; Clarke, *Trans. Med.-Chir. Soc.*, 1874; Debove, *Psoriasis Buccal*, Paris, 1873; Buzenet, *Le Chancre de la Bouche*, Thèse inaug. Paris, 1858; Neligan, *Dub. Quart. Journ. of Med. Science*, 1862; Hulke, *Trans. Clin. Soc.*, 1869, *Med. Times and Gaz.*, 1861, 1864, 1873; Morris, *Brit. Med. Journ.*, 1874; Weir, *New York Med. Journ.*, 1875; Nedopil, *Archiv f. klin. Chir.*, 1877; Trelat, *Bulletin de la Soc. de Chir.*, 1875; Schwimmer, *Vierteljahressch. f. Dermat. in Syph.*, 1877–78, and others.

which is the earliest date of appearance of epithelioma noticed after the white patches first appeared. Taking 29 cases in which data on this point are given, the average time for the supervention of cancer on the condition was 14 years and a fraction. Only in one patient (æt. 24) has cancer supervened on leucoplakia before 35 years of age. From 35 to 45 it has done so in 7 cases; from 45 to 55 in 17; and from 55 to 65 in 13; after that age only in 2 instances. These white patches have made their first appearance at ages ranging from 16, 18, 19 to 69.

Taking these facts into consideration, we have a certain amount of evidence that the disease is, in some cases at all events, a precursor of epithelioma. But, on the other hand, that it cannot be regarded as certain to develop into this disease, seeing that it has lasted, in some instances, as long as thirty or forty years with no trace of malignancy. It must also be remembered that probably only a small proportion of the individuals who are affected with this complaint come under medical notice, many of those in the above list having sought relief only on account of the development of the cancer. It is also worth noting that the latter has appeared in these cases most frequently at the same ages at which cancer, without any leucoplakia, is most frequent (see p. 590).

But so much at all events is learned from these facts—namely, that the existence of the condition should always lead to a careful examination of the tongue from time to time in search of any possible traces of spreading induration under the surface, which should at once be removed by free excision. Also that with such a condition the patient should be warned against all avoidable irritation of the tongue, and of the necessity of careful and prolonged treatment in the direction of allaying such as may exist, whether it be local or reflex, and of softening and removing by easy stages the thickened masses of keratinous epithelium of the white patches.

This *treatment* will consist then in abstention from the use of tobacco, either smoked or chewed, as well of all kinds of spices or hot solids, fluids, or raw spirits. Then the teeth must be constantly attended to for the removal of all rough edges or tartar, the mouth being regularly and carefully washed. For the latter purpose the most suitable fluid is a solution of Bicarb. Sodæ of the strength of twenty grains to the ounce of water. This should be used frequently during the day and allowed to rest around the tongue for long periods. In two cases now under my care I have noticed first great increase of sensitiveness of the tongue under the use of the above soda wash, and then some considerable improvement of the condition. The use of caustics cannot be too strongly deprecated; they can only aggravate the condition. Washes of Bichloride of Mercury, $\frac{1}{2}$ per cent., or of Chromic Acid of 1 per cent., are also recommended by Schwimmer [1] and Hilliaret,[2] but the author would trust rather to the soda solution.

But if the disease produce any nodular induration of the tongue, and any of the plaques become the seat of a slight discharging fissure or ulcer at the hard point, surgical aid should be at once invoked, and the condition be dealt with as one of epithelioma. In such cases we should not wait for the development of a distinct cancerous nodule, for it may and probably will be absent from the first, its place being taken by a shallow rugged induration spreading around the fissure alluded to.

As to the question of operative interference in the earlier stages of the disease before induration or breach of surface have taken place, it is negatived by many of the facts cited above—namely, that the disease has existed in several cases harmlessly for over thirty and even forty years. In face of this fact it would be rash to prognose the supervention of epithelioma, and to operate at once in all cases; but our other facts above indicate with what extreme care and suspicion the disease should be watched, and how promptly it should be dealt with if it show the slightest tendency to proliferation downwards of the epithelium. Here the only proper treatment is partial or complete excision of the tongue (see p. 600 *et seq.*)

Somewhat allied to the last affection histologically is another condition known to many surgeons as the 'glazed red tongue.' It is chiefly of importance to be familiar with this condition, from the fact that it, too, is often observed as the precursor of epithelioma. I have quite recently removed a great part of the tongue from a male

[1] *Trans. Internat. Med. Congress,* 1881, vol. iii. p. 173. [2] *Ibid.*

æt. 62, in whom the condition was well pronounced. Here the surface of the organ was marked by irregular patches of a glazed red appearance, as though denuded of their topmost layers of epithelium; they are not indurated in the least, but are rather abruptly defined against the rest of the tongue. The condition is most seen near the borders of the anterior part of the organ, and is pitted in one part and perhaps raised in another. It is not painful, and may not be noticed by the patient for a long time. It is apt, however, sooner or later to become the seat of small irritative blisters or very small abrasions or ulcers, one of which, too, frequently becomes indurated at its base, and develops into a nodule of epithelioma, as in the case above mentioned. It does not appear to be due in any way to smoking or syphilis, and its ætiology requires further study. It appears probable that it may correspond to the earlier stages of leucoplakia as described by Schwimmer, the heaping up of keratinous epithelium not taking place for some unknown reason.

2. *Ulcerative.*—We have now to consider the ulcerative inflammations of the tongue; and first those due to *local* irritation, of which there are several.

First, that produced by the irritation of the sharp edge of a decayed tooth, or one coated with tartar. This is usually an abrupt irregular depression seated on the border of the organ with a zone of inflammation, but with little or no induration around it. The surface is generally covered with white or greyish pus, and is acutely sensitive; the movements of the tongue, too, produce a sharp cutting pain at the spot. The lymphatic glands under the jaw are not enlarged as a rule.

The cause of this ulcer is usually easy to discover, and its removal, either by cleansing or extraction of the offending tooth or filing down of the sharp edge, is often followed by rapid healing. If this be not the case, the use of Chlorate of Potash washes of the strength of gr. x. to ℥j. of water will generally help the process materially.

The same form of ulcer may result from the irritation of badly-made false teeth, or may follow on a bite of the tongue or the chafing of the rough stem of a pipe. In the latter case the ulcer is inclined to be more chronic, and, consequently, to have a trace of induration about its base. The same may be said of the sore which often follows the smoking of an unusual amount of tobacco, which is inclined to be indolent. In all these cases, however, if recent, the withdrawal of the exciting cause, with the use of the above mouth washes, will suffice for a cure. These ulcers should be very carefully watched, for there is always a danger of any one of them developing into epithelioma, especially in patients in middle life.

The ulceration caused by the excessive use of mercury is perhaps less common upon the dorsum of the tongue than on its under surface and the rest of the cavity of the mouth. It appears to be due to over-stimulation of glandular structures of the latter, and is not difficult to recognise. In moderate degree it presents the appearance of shallow irregular patches with a red border suppurating freely; in more advanced cases the surface of the ulcer is soft, pulpy, and much depressed as a consequence of the sloughing action, which is considerable. The appearance of the ulcer, and the state of the other parts of the mouth, together with the salivation and great fœtor present, and the knowledge that mercury is being taken, can leave little doubt as to the nature of the condition, unless, indeed, the drug have been administered for syphilitic ulceration of the mouth, when it is sometimes a little difficult to say exactly how much is due to the disease and how much to the remedy. Discontinuance of the latter, however, will soon clear up any doubt, especially if washes of chlorate of potash be freely employed for the mouth, and the patient receive a few hot baths, fresh clothing, and change of air. Under this treatment the mercury is soon excreted from the body (especially if the bowels are acting freely as is usual) and the ulcer soon heals. Sometimes, however, as a consequence of this destruction of tissue, a contracted cicatrix is formed, and the tongue is bound down more or less to the floor of the mouth. This condition, sometimes spoken of as ankyloglossa, when it is complete, though strongly resembling, is very different from that in which the borders of the tongue are level with the floor of the mouth, simply because the organ has failed to rise from the latter in the course of development (see p. 555).

And when it is found in young patients we should carefully examine the whole mouth and the history lest we should fall into the error of operating on a congenital defect of the kind. Where the tying down of the tongue is due to the cicatrisation described, a little dissection will usually free the organ again, and attention to the healing of the fresh wound and stretching of its base with the finger daily while cicatrising will prevent it from recontracting, though not always.

Besides these ulcers due to local irritation, there are others depending upon *constitutional states* which must be considered.

First, there is the little ulcer of gastro-intestinal irritation often called the aphthous ulcer. This is most frequently found in unhealthy children as the result of ill feeding with acid foods, *e.g.* fermenting milk, sour bread, &c. It is also met with among young adults during attacks of indigestion accompanied by acid eructations, &c. It is usually seen on the border or under surface of the tongue in the form of a small punched-out circular depression with a white base and an abrupt red margin. It is produced by irritation of one of the mucous follicles of the tongue, and is therefore most frequently met with wherever these are most abundant—viz., under surface of the tongue, lips, and cheek. The pain produced by these little lesions, for they are usually multiple, is usually sharp and cutting, and quite out of proportion to their importance otherwise.

The treatment will consist in attention to diet, the use of antacids and alteratives, such as the grey powder for children, with tonics ; then Chlorate of Potash washes for the mouth. These ulcers usually heal readily when thus treated, disappearing as fast as they come, often in a few hours.

Sometimes, as the result of very insufficient and ill feeding and the neglect of cleanliness of the mouth and teeth, these little ulcers appear in an aggravated form and spread freely until they become confluent. This form of *stomatitis* is not unfrequent on the gums and under surface of the tongue, the movements of which produce much pain. Owing to this the patient is debarred from the use of solid food, and the condition is thus often aggravated by the want of it. The fœtor and discharge from the ulcers is also very hurtful to the general health. This condition calls for the same treatment as the last, and is usually easily managed. If it be neglected it may give rise to ankyloglossa, which may call for operation as already described. Although usually met with among children I have not unfrequently observed it among adults in a very advanced degree.

The *stomatitis* of scurvy is often, too, found within the mouth. It closely resembles the last described form, and hardly therefore requires a special description. The treatment moreover will be practically the same.

The tongue is also sometimes, but rarely, attacked with extensive ulceration during the specific fevers ; generally this is quite superficial, but cases have been described in which the organ has been totally destroyed during small-pox.[1]

Certain other forms of ulceration due to the breaking down of new deposits in the substance of the tongue will be alluded to in a later section devoted to the consideration of the neoplasms found here.

3. *Parenchymatous inflammation* of the tongue is perhaps the rarest form of the inflammatory affections of the organ. Its causes are manifold. It is not often, however, due to local irritation, but is rather the result of more general influences. In the greater number of cases it is produced either by the effects of mercury going beyond the provoking of ulcers as described, by exposure to severe cold and damp, or by the introduction into the mouth of irritating or septic matters. More rarely it is met with in the course of the specific fevers.

However caused, the effect upon the tongue is generally much the same in each case. One on both sides of the organ commence to swell rapidly, and frequently to the extent of protruding from the mouth. As it presses against the teeth it becomes indented and irregular : its surface is of a livid colour, smooth and glazed where it lies within the mouth, but brown and dry where exposed to the air. There is usually besides a very free secretion of saliva, which dribbles from the mouth in large quantities.

[1] Roland, *Aglossostomatie*, 1630.

Pain is not so marked as might be expected, but there is much distress from impeded deglutition and respiration, which may run on to an extreme degree. When the inflammation runs very high the tongue becomes deeply livid or nearly black, and may even slough in part or entirely. Occasionally one side of the face is swollen at the same time.

The rapid swelling in all cases is probably best explained by inflammatory exudation pressing upon the veins and lymphatics about the root of the tongue and preventing the reflux of blood and lymph from the part. It is easy to imagine this occurring in the case of exposure to cold where the glandular structures at the root have become affected. Or, again, where the tongue has been poisoned directly (as in the case cited by Clarke, where a butcher wounded the part with a foul knife while holding it between his teeth) the enlargement of the lymph-glands about the root would give the obstruction. But in other cases it is not quite clear what the course of events in the process really is, as, for instance, in the acute fevers.

The local treatment of acute parenchymatous glossitis is, as a rule, simple. Without making any allusion to the older methods, it may be plainly stated at once that the plan which has now gained the general favour is that of free scarification or incision. The use of leeches is followed by considerable benefit, but the knife will do all that they can do much more rapidly and effectually and with less suffering to the patient. It is used as follows. A curved, sharp-pointed bistoury is guarded with a strip of sticking-plaster to within half an inch of its point. This is then thrust into the base of the tongue about half an inch external to the middle line and drawn forwards, cutting well into the lingual tissues, the incision being repeated on the opposite side unless the glossitis be unilateral, as is the case in rare instances. This operation is usually followed by a free flow of serum and a moderate or small amount of blood, and in the course of a few hours the tongue has mostly returned to its normal size. If this be not the case, the incisions may be repeated and hot-water gargles freely used. This, however, is rarely called for. A large blister may also be applied across the hyoid region.

The general treatment will consist in smart saline purging, with a little antimonial wine in sthenic cases; in those due to sepsis, quinine in free doses will be indicated.

Sometimes glossitis is not so acute and diffused as in the cases just described, but is localised in one part of the body of the organ. This was well seen in a patient under my care some years ago. He said that he had had a severe chill from exposure some time before, and complained of a fulness in his tongue. On inspection of the latter, I found its right half slightly swollen, but otherwise presenting little signs of inflammation. On palpation, however, I detected fluctuation, and an incision at this spot gave exit to a drachm or two of pus. The cavity in this case shrank and disappeared in a few days. There was here no evidence of any cause except exposure, the man being healthy in every respect.

Syphilitic Affections.

The *syphilitic diseases* of the tongue may perhaps be best considered in a special paragraph by themselves, holding as they do a somewhat uncertain position between the inflammations and the distinct new formations, at least as regards nomenclature.

Syphilis manifests itself in several ways in the tongue, and at any age. Hitherto but little notice has been taken of the congenital affections as they appear here; but there is reason to suppose that when looked for more carefully in those suffering from congenital syphilis, they will be found more frequently. In conversation with Mr. Bryant lately, he mentioned a case which had quite recently come under his notice, in which among other well-marked evidences of the inherited disease in an infant he had found a typical mucous papule on the tongue at birth. There can be little doubt that instances of gummatous nodules will also be found when more attention is given to the organ at birth in these cases. This has been the history of the gummata in other parts in congenital syphilis, and there is no reason why the tongue should prove an exception.

Occasionally we meet with primary sores on the tongue; but though we must

remember the possibility of their occurrence, they are so rare that they need hardly count in any case of differential diagnosis. Their characters are similar to those presented by primary sores elsewhere, and need hardly detain us.

So far as we know at present, the earliest constitutional syphilitic lesion of the tongue is what is known as the mucous papule. This is met with, as a rule, within three months of the primary inoculation, and at the same time that mucous papules show themselves on other parts, such as the lips, vulvæ, and anus. On the tongue, the appearance produced by the lesion is the same as that seen on other mucous surfaces. The covering of the organ seems raised in usually oval or circular patches, which are of a pearly grey colour and covered with half-macerated epithelium which gives the mucus upon them a milky look. These patches may be met with on any part of the tongue or other part of the cavity of the mouth, but are less common in the former situation. They consist of an infiltration of the papillary layer of the tongue with small round cells whose pressure has disturbed the nutrition of the epithelial layers above. There is no pain or tenderness about them, and they give rise on the whole to little inconvenience. For this reason they may be overlooked by the patient, whose attention is probably engrossed by the appearance of the secondary rashes in the skin which develop about this time.

Except from the point of view of diagnosis, these syphilitic papules of the tongue are of little importance ; they usually disappear readily under the influence of moderate doses of mercury, leaving no trace of their previous existence behind. Rarely, they are stubborn and require to be treated locally. Perhaps the best application in this case is a rather strong solution of Perchloride of Mercury used as a mouth wash ; or the papules themselves may be rubbed over with nitrate of silver occasionally.

The next syphilitic lesion met with is one which usually appears at a somewhat later period in the constitutional disease—namely, at that stage which we are accustomed to speak of as the late secondary. It is characterised by a superficial diffused infiltration with the same round-celled deposit as in the last case, which has a tendency to break down in patches, leading to very shallow ulceration, irregular in outline and extent. Those portions not yet ulcerated are very slightly raised, are usually of a dark bluish-pink colour, and are quite smooth on the surface, although generally the latter may be a little rugged or fissured. The ulceration which takes place is usually very shallow, and may spread at one border while healing at another. It may, however, in a few cases form deeper cracks or fissures on the surface, but never usually to any great extent. After this form of syphilitic infiltration has been absorbed or removed by ulceration, which has healed, there is very often a remarkable staining of the recovered epithelium left behind. Over the area once affected there is now a bluish-white milky stain, of more or less deep tint, sometimes almost quite opaque, but usually allowing the colour of the deeper structures to shine through. After a time this will gradually disappear, owing probably to the altered epithelial cells being shed off in the natural course of things. This condition, when combined with the wrinkling or fissuring referred to above, is sometimes spoken of as psoriasis of the tongue, a term which has little to recommend it. It is sometimes confounded with leucoplakia or ichthyosis glosses; but as we have seen that the latter disease is frequently, if not always, produced independently of syphilis (p. 565), the mistake ought for the future to be avoided, the true syphilitic affection being usually easily cured by ordinary anti-syphilitic treatment, the other being, if anything, only aggravated by it.

In the treatment of this secondary syphilitic condition local applications are rarely needed, and the constitutional remedies are usually quite sufficient for a cure. Occasionally, however, it is found that mouth washes appear to hasten the healing process. These may consist of strong solutions of Perchloride of Mercury or Bicarbonate of Soda, which I have observed to be of use in some cases. But in spite of all remedies the wrinkled and fissured condition of the organ will often remain long after all ulceration has healed.

The last syphilitic lesion of the tongue to which reference will be made here is that found usually late in the tertiary stage of the disease, in which the small-celled

deposit takes the form of a distinct circumscribed knot or nodule in one or other part of the organ. This knot or gumma, as it is called from the consistence of the material of which it is composed, is usually seated in the body of the tongue, contrasting thus with epithelioma, which, as will be shown later on (p. 593), commences generally on some part of the border, though not invariably. The granulation tissue of the gumma is seated in the muscular substance, and within the mass are found traces of the muscle fibres more or less altered. When such a gumma is fully developed and of any considerable size, it produces some discomfort to the patient on account of its bulk, but little or no pain as a rule if unbroken on the surface. It is felt as a soft elastic swelling, so elastic, indeed, as to give the impression to the finger of a fluid collection in many cases. The surface of the organ during the formative stage of gumma may or may not be altered. If the deposit approach the surface very nearly, the nutrition of the epithelial layers is usually somewhat disturbed, but beyond this little is noticed. But when degenerative changes take place in the mass the case is different, and the most superficial coverings of the nodule are involved in them. The changes met with in the gummatous material are the same here as elsewhere. It may either undergo resolution and absorption, or fibrous, calcareous, or caseous metamorphosis. When fibrous, a knot covered by a puckered depression may remain for a long time in the tongue, and the calcareous matter (which is rare, however, in this situation) may be mixed with the fibrous material. But when caseous degeneration takes place the softened material assumes the characters of a small cold abscess elsewhere. It remains perhaps quiescent for a longer or shorter period, and may even, under treatment, be absorbed, but in the majority of cases it works its way to the surface until eventually the coverings over it give way, and the broken-down tissue escapes into the mouth. A ragged depression is then left, with a sloughy floor composed of the softening gummatous material undergoing fatty degeneration. It is in this stage that some difficulty may be experienced in diagnosing the ulcer from epitheliomatous disease. The situation of the focus, however, helps us in the first place; then the fact that the base is sloughy, and does not present the induration always present in epithelioma; again, the edges are not hardened and nodular, but are usually somewhat undermined; finally, the glands in the floor of the mouth are not generally in any way affected in the syphilitic condition. The age of the patient may also help us, for if the ulcer be found under the age of thirty it is more likely to be syphilitic than cancerous, although, as will be shown later (p. 590), this general rule is not without exceptions.

The treatment for gumma of the tongue, so long as it has not broken down, will be that of syphilis generally. But when a deep ulcer has formed, it may be necessary to deal with the sore locally on account of the foulness of the discharge when once it has become contaminated by the ferments of the mouth. This is best done by filling the depression with powdered Iodoform after its surface has been first dried as carefully as possible. This dressing has the property of clinging very closely for days to any surface of the kind upon which it has been packed, and it will prevent all decomposition so long as a trace of it remains. If a remedy be not at hand, solutions of Chlorate of Potash or the permanganate may be used as mouth washes. But, though valuable, they do not come up to Iodoform, which is coming more and more into use as a dressing for all wounded surfaces about the mouth. As a rule these deposits or their results disappear readily under the ordinary anti-syphilitic treatment, but from time to time we meet with cases which are very stubborn, and resist all our efforts to remove them. Such cases should always be looked upon with suspicion, for it appears to be established that epithelioma may develop out of chronic syphilitic ulcers. There is nothing incredible in this, in view of the fact that prolonged irritation of any kind may be an exciting cause of cancer in one predisposed to the disease in other ways. In one of my own cases, that of a woman of twenty-six years of age (the earliest at which I have operated for epithelioma of the tongue), the cancerous growth appeared to develop at the seat of gumma. That the disease was epitheliomatous was unfortunately proved after excision of the organ, not only by microscopical examination, but also by the recurrence which took place in the glands of the neck and ultimately destroyed life.

Tumours of the Tongue.

The most important group of diseases of the tongue now remains for consideration—namely, the tumours found in the organ, including those more strictly called neoplasms.

These all may be classed roughly into five groups: 1. The Vascular; 2. The Cystic; 3. The Lupoid and Tubercular; 4. The Connective-Tissue Group; 5. The Epithelial Group.

1. *The vascular tumours.*—Of the vascular tumours, we have already considered one—namely, lymphangioma, under the name macroglossia, usually given to the condition of the tongue produced by the change in the lymphatic tissue.

The next—namely, nævus—is perhaps the most common of all this group. This is usually first noticed shortly after birth, either confined to one portion of the tongue, or involving part of it and the floor of the mouth, lip, or cheek. Sometimes it is associated with some lymphangiectasis, in which case proneness to attacks of swelling and tenderness in the part is marked.

For a description of the minuter structure of nævus the reader is referred to the essay on Tumours. It need only be said here that nævi of the tongue present themselves either as small strawberry-like circumscribed eminences projecting from the surface of the organ, or as a more diffused vascular growth of the lingual substance proper.

The condition may be present to a considerable extent without producing any inconvenience, and may fail to increase in extent in many cases. But in other instances the tumour enlarges rapidly, and causes difficulties in eating and swallowing which call for interference. There are also risks of severe hæmorrhage from wound of the vascular tissue by the teeth during eating, or as the result of a blow or fall upon the chin. For these reasons, an operation is called for in many cases, and in the choice of the latter considerable room is given.

In the case of small more or less prominent growths which can be easily isolated, it was formerly the practice to pass a ligature round their base and strangulate them *en masse*. Here, however, as in the case of other tumours of the tongue, the use of the ligature is being abandoned for better methods. In such a case simple and free excision with the scissors is much preferable, the bleeding, if healthy tissue be cut into all round, being inconsiderable. But, if there be any particular cause to fear bleeding, the growth may be removed by the Paquelin's Cautery Knife, the tongue being drawn out of the mouth. This is an excellent mode of dealing with such tumours when small.

If the growth be large or diffused over a considerable area of the tongue, it is better to deal with it by excision, using the twisted wire écraseur (fig. 136) by preference, and working in thoroughly sound tissue. The use of the cautery here either for puncturing or excising the growth where a large surface is involved, is not desirable, in view of the irritating fœtor resulting from the sloughing action set up by the burn, the risks of which will be alluded to later on (p. 608), where the modes of using the écraseur will also be described.

Cirsoid aneurism of the lingual vessels has also been observed in one case at least. This is recorded by Sir J. Fayrer,[1] who describes it carefully, as also the mode in which he treated it. Apart from the abstract pathological interest of this case, it is of clinical importance from the fact observed—namely, that the tumour was very like an ordinary ranula of large size, and might possibly be mistaken for such a condition.

2. *Cystic tumours.*—We turn next to the fluid or cystic tumours of the tongue.

Of these the first, and apparently rarest, is the *hydatid* which has, however, been found here as in other parts of the body. The treatment, too, will not differ from that adopted elsewhere for these parasitic cysts.

The next kind of cyst occasionally met with is one due to the dilatation of one

[1] *Clinical Surgery in India.*

or more of the *mucous follicles* of the tongue. These may occasionally attain considerable size, and may be misleadingly like colloid cancer of the organ, as in a case quoted by Weber[1] from Schuh's practice. They are very thin-walled and full of a tough gelatinous mucus, and do not project much over the level of the tongue surface, though they may attain a considerable size. The treatment of such tumours will be the same as that adopted for ranula, a condition now to be described.

The swelling to which the term *ranula* is applied is usually found either in front of the under surface of the tongue close to the frænum or more generally at the side of the organ. It may be congenital or acquired; its appearance is very characteristic: it is smooth on the surface, of a dark pearly bluish-pink colour, and, even casually viewed, gives the idea of translucency; it is also distinctly fluctuating, the sensation being felt either with the finger in the mouth or, if the tumour be large, under the ramus of the jaw. The size is usually from that of a filbert to a walnut. These swellings are due to the distension of a part or the whole of one of the sublingual glands with normal mucus. This is not necessarily a consequence of blocking of the duct, which, as Sir W. Fergusson[2] has shown, may be found quite permeable to a probe, but may be a simple dilatation of the follicles of the gland. The contents are usually glairy, either quite clear and colourless, or else of a pale straw tint, and are enveloped in a very thin-walled sac.

The treatment of these mucous collections, whether under or in the tongue, is not always a simple matter. If they are moderate in size, the better plan is to dissect them out as a whole. But, if larger, this would be rather a troublesome operation, if not actually dangerous from hæmorrhage. It is better, therefore, in the first place to try the effect of simple incision and drainage. It is done by making a cut with a sharp, curved bistoury, by transfixion through the most prominent part of the swelling. When this has been done, the sac very often drains, and shrinks completely without any trouble, and the disease is at an end. It very often happens, however, that this wound thus made heals too readily, and the fluid re-accumulates. This may even occur after repeated evacuations of the contents. In such a case the greater part of the external wall of the sac may be cut away with scissors, and the resulting hollow dressed with a piece of lint dipped in Tincture of Iodine. This is usually sufficient to obliterate these cavities, but even after this treatment the hole made may close over and mucus re-collect. If this take place, a V-shaped incision may be made in the external wall, and the triangular flap of the mucous membrane so formed may be turned into the sac, doubled on itself, and fixed thus with a single stitch. By this means a mucous surface is always opposed to the edges of the healing wound, and thus union is prevented, the sac shrinking. In the only case which I found it necessary to adopt this method I found it to answer very well. Sometimes it may be more desirable to excite inflammatory obliteration of the cyst by running a seton across it, and allowing it to remain there for some days.

But though ranula need not depend upon blockage of the duct of the gland, the latter is not unfrequently found to be obstructed by a hard concretion of phosphate of lime deposited from the secretion of the organ. Such a salivary calculus is easily felt upon the floor of the mouth as a hard stony knob covered by the mucous membrane of the latter. It can hardly be mistaken for any other tumour in this situation.

The treatment will consist in making an incision over the whole length of the foreign body, and in dislodging it with a small scoop, with which it can be levered out of its bed as a rule without much difficulty. In a few cases, if the calculus be rough, it may not be easy to dislodge it from the mucous tissues in which it is imbedded, and it may be necessary to break it up in situ rather than dissect or tear it out, which might produce considerable bleeding. Should the latter be smart, it may as a rule be controlled by the sucking of ice, and if not by this, by the application of lint dipped in Perchloride of Iron Tincture.

The last of the cysts of the tongue which it is necessary to notice are those containing *sebaceous matter*. These derivatives of the dermal structures may be found

[1] *Pitha-Billroth's Handb. d. Chir.*, Einband vi. p. 329.
[2] *System of Surgery*, 5th ed. p. 513.

either in the mid line of the organ or at one side—in other words, in those two situations where embryonic clefts exist, and where infoldings of some of the elements of the cutaneous structures may occur. Such cysts are rare, and but few notices of special cases are to be found recorded in our literature. I can only refer to two instances of the occurrence of a sebaceous tumour of the tongue in my own practice. The first was seated in the middle line, between the genio-hyoglossi muscles, and was about the size of a walnut. It produced a considerable amount of difficulty in swallowing, and much discomfort. The patient, a woman of about five-and-thirty, was very anxious for its entire removal, which was accomplished without much trouble from the mouth. Having discovered the nature of the swelling by incision and the evacuation of the porridge-like contents, I seized the tough wall of the cyst with a strong forceps, and drawing on it firmly, was able to enucleate the whole in one piece by a dissection with a blunt director, although the cyst reached quite to the hyoid bone between the two muscles. The bleeding and pain were insignificant, and ceased almost immediately after the operation, the wound healing in a few days. On examination, the sac was found to have very thick walls composed of tough fibrous tissue, which was but loosely attached to the surrounding structures. The second is at the present moment under my care, and is the same in every essential particular, except that it is larger and does not produce any discomfort. The patient has not yet made up her mind to operation. Sir W. Fergusson [1] records another case of this same disease, which was remarkable for the great size which the cyst attained, and the trouble which was encountered in dealing with it. It was as large as the fist, and was prominent under the chin on one side as well as thrusting the tongue upwards, giving rise to much inconvenience. The sac of this tumour was only removed after extensive dissection, both from the mouth and side of the neck, during which the patient lost much blood. He made a good recovery, however, in a very short time. The only special point to be attended to in dealing with such sebaceous cysts is their entire and complete removal. Unless this is attended to, troublesome discharging fistulæ are the only result of opening them or attempting to cause their obliteration by inflammation.

3. *The lupoid and tubercular group.*—Lupus of the tongue is a disease of great rarity to judge by recorded cases. I have only been able to discover one such, in which the diagnosis could be said to be established beyond all reasonable doubt. The specimen was exhibited to the Pathological Society in 1875, by Mr. F. Clarke, who had shown the case to Sir James Paget, who had made the diagnosis. The patient died of exhaustion, from inability to swallow food, and the tongue on removal was found to be infiltrated with small round cells, in the way usually found in lupus. Probably the best treatment in a case of this kind would be excision of that part of the tongue in which the disease lay, if the latter were of moderate extent; if otherwise, in free scraping away of the lupoid tissue over the affected area.

Tubercular disease of the tongue, on the other hand, is probably not so rare as has hitherto been supposed, and attention has recently been drawn to several instances of the disease in its early stages and accurate descriptions given. One of the best essays on the subject is that of Nedopil,[2] who describes the affection very carefully, however one may be inclined to question some of his conclusions.

As the author has seen it, the disease has been present in the form of a small ulcer or ulcers on the dorsum of the tongue far back. These showed a sharp margin with a deeper red colour than the surrounding tissue, and a white shreddy base; they were irregularly circular and considerably excavated; their margin gave evidence of considerable deposit, without very marked induration; they were associated with similar disease of the soft palate, and other evidences of tuberculosis. I had no opportunity of examining the growth with the microscope. Nedopil has described the affection at an earlier stage, and has had an opportunity of examining the structure of the base of the ulcers microscopically. Here he has found the well-known miliary granulations of tubercle, either disseminated or aggregated, and break-

[1] *System of Surgery*, 5th ed. p. 514.

[2] *Archiv f. klin. Chir.* Bd. xx.

ing down towards the surface of the ulcer. He suggests that it may be possible by a careful study of this affection of the tongue in the future to recognise its nature early enough to admit of its removal before extensive ulceration has taken place, and (inasmuch as the deposit may be primary) before possible generalisation of the tubercle have taken place from the original focus. Whether this be the correct treatment for this disease or not further experience must show. At present we rely rather upon scraping the base of the ulcer freely with a sharp spoon, and dressing it with Iodoform or Tincture of Iodine, than on the more radical operation of excising the portion of the tongue in which the ulcer lies.

It is a point of some little interest that the first of Regnoli's operations for excision of the whole tongue (see p. 602) was performed for what was described as a tubercular ulcer of the organ, in a girl of fifteen. It is more probable, however, from the description that the affection was more of the nature of lupus.

4. *The connective-tissue group.*—The next group of tumours of the tongue to be considered is that made up of the solid growths derived from the connective-tissue structures.

The first and by far the most frequent of these are the papillomata. These consist of the hypertrophied papillæ of the organ, and may be found on any part of its dorsum. They are most frequent, however, far back, and may be single or multiple. They are often congenital, but not always. They consist of a considerable increase of all tissues of the papillæ in about equal proportions in most cases. In some, however, the epithelial coverings are proportionately over-thick and are horny to some extent, as in a case alluded to by Weber.[1] Again one of the circumvallate papillæ may be hypertrophied, and exhibit in its interior glandular and enlarged nerve-elements as found by Billroth (*ibid*). Such growths may be either sessile or pedunculated, and may attain considerable size; one described by Dr. Huie weighing as much as an ounce on its removal by operation.[2]

When such tumours are found in children or young persons, they may be looked upon as quite benign; but when met with in mid life should always be regarded with a certain amount of suspicion, cases having been recorded in which they have developed into typical epithelioma. I have seen two or three such, in which, after excision, their true nature was seen to be epitheliomatous.

The treatment will consist in their removal either by the scissors, which is the simplest and best, or by the knife, cautery, or wire écraseur. When very small, free rubbing with nitrate of silver may suffice to lead to their being shed off rapidly.

Fatty tumours are also met with in the tongue, either embedded in its muscular substance or on its under surface, but rarely of any great size: they are very unusual, but cases are alluded to by Weber, and another is recorded in the 'Progrès Médical,' Dec. 11, 1880. Their removal is a matter of small difficulty, as they 'shell out' of the surrounding tissues readily, leaving a wound which soon heals.

Fibromata and *fibro-cellular* growths have been met with more frequently. These may be imbedded in the tongue, or may hang as pendulous masses from its surface, as in an interesting case recorded by Mr. Mason,[3] where the tumours had attained the size of plums before relief was sought. In another case, alluded to by F. Clarke,[4] one of these fibro-cellular tumours was removed from the tongue, on which it had been seated for twenty years, and was found to weigh a quarter of a pound. Many other less remarkable cases might also be cited of the same kind of growths.

Enchrondromata have also been found here, and a remarkable case is described by Weber,[5] in which he found such a growth of about the size of a walnut to contain masses of fat surrounded by and imbedded in cartilage. He mentions further that enchrondroma has also been found here by Velpeau, but beyond these cases I am not able to find any record of this particular neoplasm having been observed in the tongue.

[1] *Pitha-Billroth's Handb. d. Chirurg.*, Einb. vi. p. 328.
[2] Clarke, *Diseases of Tongue*, p. 210.
[3] *Trans. Path. Soc.* vols. xv. and xviii.
[4] *Diseases of Tongue*, p. 213.
[5] *Pitha-Billroth's Handb. d. Chir.* Einb. vi. p. 329.

Another very remarkable growth belonging to this group has also been observed on the tongue, at least in one case: this is keloid, which was associated with patches of the same disease in other parts of the body.[1]

This leads us to consider the more truly sarcomatous growths in their relation to the tongue, and here it may be stated at once that as primary diseases they are almost unknown. I only know of one such case, in which, however, it might be questioned whether the condition of the tongue was altogether primary. The patient was under the care of my colleague Mr. Godlee, at University College Hospital, and when first seen had a somewhat pendulous growth upon the dorsum of the tongue. This was removed, but recurred before very long. There were also several growths of the same kind a little later on the skin of different parts of the body, so that the case on the whole was one of those rare forms of multiple sarcomata, to which attention has been lately drawn, but whose peculiarities require further study.

5. *The epithelial group.*—Turning now to the distinctly epithelial neoplasms observed here, we find that they are only two—scirrhus and epithelioma. The first of these has been met with, but is extremely rare. Thus, out of sixty-six cases of tumour of the tongue, occurring at University College Hospital (see p. 580), only one was distinctly of the nature of scirrhus. The latter form of disease, as it occurs here, requires no special notice, presenting no peculiarities either as to characters or treatment, which would be the same as that for epithelioma.

But by far the most important tumour of the tongue is unquestionably *epithelioma*, and this for several reasons.

In the first place, of all the new growths developing in the organ, it is the most frequently met with, if we except syphilitic gummata, which may also be classed among the neoplasms. On this point I may first quote in evidence a careful collection of all the cases of tumour of the tongue, admitted into University College Hospital during the eleven years 1871-1881 inclusive, which I have tabulated from the hospital Case Books, greatly assisted by the valuable Reports furnished yearly by our Surgical Registrars. Cases presenting themselves as 'out-patients' have not been included in my list, which will be found below (p. 580).

Now, of the in-patient cases of tumour of the tongue alluded to, amounting in all to 66 (inclusive of 4 gummata of the tongue operated on by error or as suspicious), I find that there were only 10 not epitheliomatous, or 6 if we exclude the syphilitic deposits; these tumours were 2 Nævi, 1 Scirrhus, 1 Papilloma, 1 Sarcoma, 1 Lymphangioma. In out-patient practice the preponderance of gummata would of course be very great, but, leaving these out in this case, epithelioma stands far in advance of the other tumours of the tongue in frequency as demanding operation. Scirrhus, as already noticed, was only found once among 66 patients suffering from growths of the tongue, and the same was the case with sarcoma.

As further evidence on this point we may mention that, among 46 cases admitted for excision of the tongue into Billroth's Klinik within eight years (Oct. 1867 to Jan. 1876) and tabulated by von Winniwarter,[2] and 48 between the years 1877-80 tabulated by Woelfler,[3] no mention is made of either of these last or other neoplasms, except gummata and tubercular nodules.

And, even admitting that there are many tumours of the tongue which would not necessitate a stay in hospital for their removal, my own observation of many thousands of out-patients confirms the conclusion as given above, derived from a study of the literature of the whole subject—namely, that epithelioma is the commonest neoplasm of the tongue, excepting syphilis, and perhaps papilloma.

Again, epithelioma of the tongue is important on account of its great frequency as a distinct affection in this country. On this point we are in need of detailed statistics; but it is worth noting that in our hospital the ratio of cases of this disease admitted during the eleven years mentioned above (amounting to 55,

[1] Sedgwick, *Trans. Path. Soc.* vol. xii. p. 234. Quoted by Clarke.
[2] *Beitr. z. Statist. d. Carcinom.* Stuttgart, 1878. [3] *Archiv f. klin. Chir.* 1881, p. 314.

excluding 4 gummata, 1 scirrhus operated on on doubtful diagnosis), stands at 4·5 per 1,000 of all the patients treated in the surgical wards during the same period, amounting to 12,199. And if, as would appear possible from an interesting suggestion made by Mr. Whitehead at our recent Medical Congress,[1] cancerous diseases be on the increase in this country, as shown by the Registrar-General's returns, we may expect that form which developes in the tongue to increase in the frequency of its occurrence too, seeing that it holds a prominent place in this group of affections. This relative frequency of cancer of the tongue as compared with other organs is a point of interest, and a glance at some of the recorded statistics of carcinoma will repay the trouble. Thus I find that 16·3 per cent. of all the cases of cancer, amounting to 343, including scirrhous, medullary, epithelial, and rodent, treated in our hospital within ten years were lingual, the breast standing at the top of the list with 36·7 per cent., the rectum coming next to the tongue with just 10 per cent. Von Winniwarter's[2] statistics of carcinoma, compiled from the hospital and private practice of Professor Billroth, give however a smaller percentage of tongue cancers to the total for all parts of the body —namely, 8·3, calculated from 543 cases; the breast standing at 32·4, and the rectum at only 4·3. But in von Winniwarter's tables carcinoma of parts of the face and lips swells the aggregate after the breast. Sir James Paget's statistics,[3] on the other hand, like our own, show epithelioma of the tongue ranking among the cancers only next to the breast in frequency. Thus, on a total of 500 cases tabulated, there were 55·2 per cent. of breast cases, and 6 per cent. of epithelioma of the tongue. In Mr. Sibley's tables,[4] compiled from the records of Middlesex Hospital for 1854–1856 inclusive, and including 520 cancers of all parts, the percentage of tongue cases is not so high, being only 2·6, while the breast stands at 36·5 of the whole. In this table, however, cancer of the uterus makes up 30·0 per cent. of the total, while it is not represented at all in Sir James Paget's or our own lists, and only to the extent of eight cases in von Winniwarter's.

While correcting the above 'copy' for the press, I have just now had an opportunity of hearing a most valuable paper on the statistics of ichthyosis glossæ, and of epithelioma of the tongue, taken from the records of the Middlesex Hospital for the years 1872–1881 inclusive, read at the Medical Society by Mr. Morris, who, with his usual courtesy, has permitted me the privilege of examining his tables and embodying his experience with the above. His figures include 501 cases of cancer of all parts, of which the breast makes up 51·4 per cent., the uterus 22·1, and the tongue 7·1.

If we combine these five tables, we have a very large number of cases of cancer from which to judge the relative frequency of that occurring in the tongue. The numbers stand thus, comparing lingual disease with that of the breast, to which it stands next if we exclude cancer of the uterus, which is not represented in Paget's or the author's tables, and only to the extent of eight cases in von Winniwarter's.

	Sibley: 520 cases (1853 to 1856) inclusive	Paget: 500 cases (1843 to 1861)	von Winniwarter: 548 cases (Oct. 1867 to Jan. 1876)	Author: 343 cases (1871 to 1881)	Morris: 501 cases (1872 to 1881)	Average percentage on total of 2,412 cases
Breast . .	36·5	55·2	32·4	36·7	51·4	42·4
Tongue . .	2·6	6·0	8·3	16·3	7·1	8·0

Looking at the figures so arranged one is struck with the great frequency of cancer of the tongue, equalling 8·0 per cent. on 2,412 cases of the same disease affecting a large number of different organs. Also, one cannot help speculating whether it is possible that the steady rise in the percentage indicated in the above tables, which are arranged chronologically, is anything more than accident. If the author's and Mr.

[1] *Transact. In Med. Cong.* 1881, vol. ii. p. 469.
[2] *Beiträge z. Statist. d. Carcinoma.* Stuttgart, 1878.
[3] 'Statistics of Cancer,' by W. M. Baker, *Trans. Med.-Chir. Soc.* vol. xlv. p. 389.
[4] 'Statistics of Cancer,' *ibid.* vol. xlii. p. 114.

Morris's lists be combined—as they fairly may be, being derived from the practice of two neighbouring hospitals during the same decennium—we have a tolerably regular series of epochs and a steady gradation from 2·6 to 11·5 per cent., a point of some little interest when we remember Mr. Whitehead's remarks suggested by the Registrar-General's returns. It may be, of course, that the possibility of cancer of the tongue being cured by operation is becoming better known than it was some twenty years ago, and that consequently many cases in the country which would then have been pronounced absolutely incurable and beyond reach are now advised to seek admission at our large metropolitan hospitals. The fact, however, is in any case suggestive.

In the next place, this tumour is most important on account of its malignancy in every sense of the word. It is not only exquisitely painful in a large proportion of cases in the advanced stage, from the necessary passage of food over the ulcerated surface, but even without this the pain is often agonising when the nerves of the tongue become involved in the cancerous change: it is then not limited to the mouth, but radiates up the side of the face and head, often to an almost maddening degree: intense pain in the ear, too, is often complained of. But the disease causes much suffering and even danger in another way—namely, by the intolerable fœtor it produces in the mouth, not only by its own degenerative changes and the decomposition of the resulting products, but also by the rotting of particles of food which collect in and around the sore and cannot be dislodged. This fœtor is not only insupportable to the patient himself, but also to those about him, rendering his life miserable. It may even prove dangerous by setting up inflammation in the lungs running rapidly to gangrene, from the inhalation of the putrid emanations night and day from the part. It is in this way that death has been caused in some cases where no operation was performed (*e.g.* instances by Moore,[1] and author's table No. 60).

Epithelioma is malignant above all in its rapid march towards a fatal termination. Of all forms of cancer there is none more swift in its development or more inevitably destructive to life within a short period of its appearance than this if left to itself.

It is usually fatal thus in one of four ways—either by generalisation and the marasmus so produced; or by infection of the cervical glands and parts around to the extent of pressing upon the œsophagus and thus preventing food from entering the stomach, as I have lately seen in a case under my own care for some time; or by the production of septic pneumonia from inhalation of foul matters generated about the growth; lastly, it may lead to a fatal issue by opening up one of the lingual vessels, or arteries of the neck, with profuse hæmorrhage, which may be directly dangerous from loss, or may produce suffocation from entrance of the blood into the larynx in large quantity.

Of the duration of life of those affected with the disease who are not operated on, from the time it first manifests itself until it kills, one can only speak approximately of course. It is, however, worth note that many independent observations on this point lead to almost the same conclusions, to which allusion will be made later on, when the operations for epithelioma have been considered (p. 606).

Bearing these points in regard to the great importance of the disease in mind, we have good reason to study it as closely as possible in every aspect of its natural history. This I have endeavoured to do personally, not only by close observation of a large number of cases clinically, but also by an examination of a great number of recorded cases, and first those which have been under notice in our own hospital, which I have tabulated in detail.

Moreover, in the hope of helping in the matter of the establishment of uniformity in clinical record of these cases, by which alone any reliable data for comparison of large numbers can be accumulated, I have so far modified the arrangement of my table as to assimilate it in structure as far as possible with von Winniwarter's and Woelfler's, which, though they differ from one another in a few minute details of form, constitute together the most complete record of the kind now extant. The subjoined list, then,

[1] *Trans. Med.-Chir. Soc.* vol. xlv. p. 47.

hardly differs in form from von Winniwarter's, except in being perhaps a little simpler, while its arrangement may be held to be somewhat fuller than Woelfler's. At all events, all three are so nearly alike structurally that they admit of being amalgamated one with the other for general conclusions or contrast, the fact of the whole group consisting of completed series constituting, however, their particular value. I have not considered it desirable to go beyond these extensive and completed series for material from which to draw numerical conclusions. Large numbers of cases which I have studied, amounting to hundreds, might have been added to them, collected here and there from the journals home and foreign, but such an addition would probably not have contributed to the accuracy of any deductions made, seeing that they were more or less isolated records, and might only be taken generally rather to represent the successful operations here or there. Such a collection, which is not of course without its own interest, will be found at the end of a recently published essay on Cancer of the Tongue now before me, by Dr. Berg of Stockholm.[1] No doubt in a few years we shall have a much larger number of complete and accurately recorded series; in the meantime it is safer to be guided by collections of the character of those referred to specially in the text.

In the following table (pp. 580–589), which has been made as full and accurate as possible, I have arranged all the cases treated for cancer of the tongue in the wards of University College Hospital between January 1, 1871, and January 1, 1882, whether operated on or unoperated on, exclusive of out-patients.

Ætiology.—The first point which suggests itself from a study of the table is whether locality has anything to say to the production of epithelioma. This is a very difficult question to decide, for want of extensive and accurate statistics. And yet here and there we find fragments of evidence which appear to answer in the affirmative. Thus a very considerable proportion of cases at our hospital have come from Wales; and within the last month or two we have had three such—two not only Welshmen, but also fellow-workmen in the same foundry, and with identically the same local tongue cancer. All this of course may be only a coincidence, or perhaps due to the fact that we have had, and continue to have, many Welsh students at University College Hospital, who on their return home would naturally refer any cases of the kind to their own hospital. But, on the other hand, we do not notice any remarkable number of breast cancers coming from Wales, as might be expected if this last were the only reason. There remains, therefore, the suspicion that locality may have something to do with the affection, especially as we are told that epithelioma of the lip is also common in Wales, which, to judge by experience at our hospital, is not the case in this neighbourhood. This suspicion is strengthened when we come to examine other series of cases where any data exist bearing on this point. Thus Woelfler notices the very large proportion of tongue cancers which seek relief in Professor Billroth's Klinik coming from the immediate neighbourhood of Vienna and Lower Austria; while breast cases, for instance, come less from here and more from localities at a greater distance. One might be disposed, perhaps, to refer this prevalence of tongue disease in certain places rather to the hard living of closely populated parts or great towns—*i.e.* the drinking, and especially smoking habits. In reference to the latter, however, we are told (von Winniwarter, *loc. cit.*) that in parts of the East, where smoking is, if anything, more habitual than in Europe, cancer of the tongue is but little known; and, again, that among 100 cases of lip and tongue cancer collected by Hertaux in Finistère, where all the women smoke short pipes, there was not a single female. The whole question, however, requires much more extensive and careful study than has been possible hitherto, before anything more than mere suggestion can be hazarded in one direction or another in regard to it. I have thought it, however, of sufficient interest to claim a passing notice here.

In the next place, the period of life at which epithelioma manifests itself claims attention. On this point the following tables, arranged by several observers from different material and at different times, may be allowed to speak without much further comment. The extremes of age at which the disease has been observed are

[1] *Studier Öfver Tungkräftan.* Af J. Berg. Stockholm, 1881.

No. Sex. Age. Abode. Date of admission	First evidence of disease, when and where noticed	Present state of primary disease. Pain	Any glands enlarged, and where	Ætiological data. 1. Heredity. 2. Smoking. 3. Syphilis. 4. Local irritation. 5. Leucoplakia. 6. Indigestion, &c.	Date and mode of operation	Course and after treatment	Immediate result	Date and cause of death	Ultimate result	Remarks
No. 1. M. 44. Surrey. Aug. 31, 1871.	Six months ago; a small lump on right side of T., growing rapidly and ulcerating about two months later.	A large ulcer extends from tip almost to base on right side, nearly reaching to the mid-line. Great pain.	Yes, forming large swelling on side of neck at angle of jaw.	No heredity. Smoking not mentioned. No syphilis. Local irritation not mentioned.	None attempted.	—	—	?	?	Patient never suffered from any illness except inflammation of lungs and gonorrhœa.
No. 2. M. 45. London. April 3, 1871.	Ten years ago began to complain of T. Eight months ago began to ulcerate on right side.	Large ulcer reaches from near the base to the tip. A separate nodule, also ulcerated, seen on tip, surrounded by thick white epithelium (?) leucoplakia.	None.	No heredity. Smoked clay pipe. Syphilis probable. No local irritation.	Declined.	—	—	?	?	This patient probably had leucoplakia for years.
No. 3. M. 44. Bedfordshire. March 17, 1873.	Three and a quarter months ago a small, painful, pimple, growing to present size.	Hard oval lump, size of shilling. No pain now. Position not mentioned.	—	No heredity. Smoking not mentioned. Syphilis negatived. Grating of sharp tooth assigned as cause.	Declined.	—	—	?	?	Never had anything the matter with T. until date mentioned.
No. 4. M. 46. London. Jan. 23, 1873.	Three months ago pipe was driven into the tongue by a blow; the wound grew to present state.	Round, deep, hard ulcer, size of a shilling, on left side of dorsum and lateral surface.	Yes, several at angle of jaw.	No heredity. Smoking not mentioned. Syphilis negatived. Wound of tongue from pipe stem.	Jan. 29. Division of cheek; muscles of T. cut with scissors, and left half removed with galv. écraseur at base.	Profuse secretion of saliva and mucus. Cough. Much fœtor, treated by Condy's fluid. Swelling of left side of face. Abscesses in eyelids and temp. fossa.	R.	?	Recurrence in glands soon after operation.	There was no hæmorrhage during the operation from T., but free from incision in cheek.
No. 5. M. 56. Surrey. Feb. 12, 1873.	Two months ago a small tubercle on right side, rapidly growing.	Large ulcer from near tip to pillar of fauces, deep and hard; nearly reaches mid-line. Not painful.	Yes, one beneath jaw.	No heredity. Smoking moderate, not habitual. Syphilis negatived. Grating of sharp tooth.	Feb. 19. Galv. écraseur applied through the mouth; considerable hæmorrhage at the time. Organ removed at base.	Bronchitis set in on 5th day, followed by pneumonia and pleurisy.	D.	Died Feb. 26 of lung complications, *i.e.*, bronchitis, pneumonia, pleuritis, and gangrene of lung.	—	The kidneys showed no signs of pyæmia, nor did the lung affections appear to be due to the latter disease.
No. 6. M. 61. Gloucestershire. April 14, 1873.	Seven months ago a sore spot on left border of T.	Large, deep ulcer on dorsum, from three-quarters of an inch of tip to *pap. circumval.*	Yes, one.	Heredity not mentioned. Smoking excessive.	April 16. Galv. écraseur from the mouth. Left half removed by two applications of loop.	Hæmorrhage on 7th day; otherwise recovery good.	R.	—	—	Pipe always smoked on opposite side to that affected.

No. 7. M. 56. London. May 6, 1873.	Six weeks ago 'a little sore lump' on left side of T., rapidly increasing.	Hard oval lump, not ulcerated, in left half of T., does not reach mid-line; Not painful.	None.	No heredity. Smoking excessive. Syphilis positive. No local irritation.	May 7. Galv. écraseur from the mouth. Laryngotomy had to be performed on account of severe bleeding from cutting away of the diseased half of T.	Had bad cough for some time after from trace of pneumonia, also rheumatic (?) pains in right knee and ankle.	R.	—	Apparent recurrence in cicatrix before leaving hospital.	Pipe smoked on opposite side to that affected. The écraseur in this case failed, and the excision had to be completed with scissors.
No. 8. M. 58. London. June 20, 1873.	Twelve months ago 'slight hardness and soreness' in centre of T., spreading to left side.	Hard swelling on dorsum. Painful at times.	Not stated.	Heredity not mentioned. Smoking not mentioned. Attributes condition of tongue to venereal disease.	None attempted; disease too far advanced.	—	—	?	?	—
No. 9. M. 41. London. Feb. 10, 18'4.	Twelve months ago a lump on left side, removed three months ago.	Hard, tender condition of T., two inches of left half of which have been removed.	Yes, many under angle of jaw.	No heredity. Smoking excessive. Syphilitic history plain. Tertiary ulcers, lasting for many years past. Gin drinker.	None attempted; disease too far advanced.	—	—	?	?	Here the syphilitic ulceration appeared to run on into the epitheliomatous.
No. 10. M. 48. London. June 15, 1874.	Two months ago a small tubercle on right side.	Hard, circular ulcer, size of shilling, on right side of dorsum, one inch and a half from tip. Much salivation.	Yes, two under jaw.	No heredity. Smokes rarely. Syphilis negatived. No local irritation from teeth, &c.	None attempted.	—	—	?	?	Very rapid in-growth and infection of glands.
No. 11. M. 61. Yorkshire. Oct. 14, 1874.	Five months ago 'sore place which never healed,' but spread rapidly.	Ulcer, $1 \times \frac{1}{4}$ inch, lying obliquely on dorsum across mid-line, with much induration; also an ulcer on under surface. Much pain.	Yes, under symphysis of jaw.	No heredity. Smokes to excess. Clay pipe. No syphilis. Drinks beer to excess.	Oct. 22. Division of attachments of T.; then removal through the mouth by galv. écraseur of two-thirds of organ.	Great fœtor; much glandular swelling in neck.	R.	—	Probable recurrence before leaving hospital; some disease left behind.	The wire of the écraseur passed through the growth in cutting its way out.
No. 12. M. 40. Portsmouth. July 30, 1874.	Four months ago a small fissure on right border, becoming harder soon after.	Irregular hard ulcer, size of shilling, one inch and a half behind tip.	None.	No heredity. Smokes to excess. No syphilis. Grating of sharp tooth.	Sept. 9, 1874. Galv. écraseur from the mouth around the whole T.	Bleeding from stump on 10th day, checked by fer. perchl., also on 13th day.	R.	?	?	Subsequent examination of part removed led to the conclusion that the growth was a gumma.
No. 13. M. 45. London. May 19, 1874.	Six months ago a lump on left border size of small pea, midway between tip and base.	Shallow, broad ulcer on left side, from one inch from tip for one inch and a half backwards.	Yes, under each ramus of jaw.	Heredity doubtful. Smokes in moderation. No syphilis. Scraping of sharp tooth and several bites.	May 26. Galv. écraseur applied through the mouth; attachments being cut with scissors. Whole thickness removed.	Great fœtor, for which Condy's fluid used; otherwise good recovery.	R.	—	Glands more enlarged before patient left hospital.	The wire loop passed through diseased tissue leaving some behind.

No. Sex. Age. Abode. Date of admission	First evidence of disease, when and where noticed	Present state of primary disease. Pain	Any glands enlarged, and where	Ætiological data. 1. Heredity. 2. Smoking. 3. Syphilis. 4. Local irritation. 5. Leucoplakia. 6. Indigestion, &c.	Date and mode of operation	Course and after treatment	Immediate result	Date and cause of death	Ultimate result	Remarks
No. 14. M. 37. London. April 25, 1873.	Three and a half years ago sore spots on right side.	Induration of whole of right side except near tip; on left is some ulceration in several parts. Much pain.	Not stated.	Heredity not mentioned. Smokes habitually. Had syphilis. T. cauterised.	None attempted.	—	—	?	?	This looks like one of those cases where syphilitic ulceration is followed by epithelioma.
No. 15. M. 38. London. Jan. 4, 1875.	Eight months ago a small white vesicle on right side, followed by ulcer and great salivation.	Large irregular ulcer on right side, half way between tip and base, with knotty induration; rest of T. shows leucoplakia.	Doubtful.	No heredity. Smokes in moderation. No syphilis. Scraping of sharp tooth. Leukoplakia.	Jan. 7. Galv. écraseur through the mouth. Anterior right half removed, a small remainder afterwards.	On 11th symptoms of cellulitis of neck set in, with high temperature. Cellulitis increased over side of neck from ear to sternum on 16th; œdem. glott.	D.	Died Jan. 18 of œdema glottidis and exhaustion and cellulitis of the neck.	—	Laryngotomy had to be performed at last, but was of little use, as patient was dying.
No. 16. M. 54. Wales. Sept. 25, 1875.	Twelve months ago an ulcer formed on right side from chafing of sharp tooth, which has gone on increasing.	Ulcer size of shilling on right side of dorsum; the entire right half of T. much indurated.	Yes, at angle of jaw.	No heredity. Smoking not mentioned. Syphilis not mentioned. T. chafed much by a sharp tooth on right side.	None attempted; disease too far advanced.		—	?	?	The history of local irritation very clear in this case.
No. 17. M. 51. London. Nov. 19, 1875.	Four months ago a number of little boils' under tip of T., which became confluent and broke.	Tip and anterior quarter of T. and floor involved in hard mass, ulcerated on left side at canine tooth.	Yes, one beneath jaw on left side.	No heredity. Smokes. Syphilis not mentioned. Pipe knocked into T. at one time.	Nov. 24. Section of symphysis in two places. Division of T. and attachments with galv. écraseur.	On Dec. 1 symptoms of bronchitis; on 4th of pleuritis.	D.	Died Dec. 7; bronchitis, pleurisy, pneumonia on both sides, most on left.	—	There was no special hæmorrhage at operation.
No. 18. M. London. July 29, 1875.	Six months ago pain and induration along left side of T., with lumps three months ago.	—	Not stated.	No heredity. Smoking not mentioned. No syphilis.	Aug. 4. Jaw divided. T. removed, with galv. écraseur placed round the base at epiglottis, which was partially removed.	On Aug. 9 symptoms of bronchitis.	D.	Died Aug. 12; pleurisy, pneumonia, with abscesses on right side; left side lungs sound.	—	The character of the abscesses in the lungs was not that of pyæmic foci.
No. 19. M. 52. London. Sept. 21, 1875.	Twelve months ago the T. became rigid and fixed on right side, and a gland swelled. No ulcer mentioned.	Unable to protrude the T., which is swollen and fixed to gums.	Yes, on both sides at angles of jaws.	No heredity. Smokes clay pipe to excess. No syphilis.	Sept. 29. Removal of symphysis and half the T. by galv. écraseur.	Great occipital pain; also in infiltrated glands not removed. Great fœtor, for which Condy's fluid was used with carbolic acid.	R.	—	Free from recurrence on Dec. 21, 1875.	The induration in the glands at the angle of jaw disappeared before the patient left hospital.

No. 20. M. 45. Kent. Feb. 3, 1875.	Eighteen months ago a small pimple with white head on left side, near tip; grew slowly.	Hard ulcer on left half of dorsum, from tip to last molar tooth; does not pass mid-line.	Yes, one in front of sterno-mastoid.	Heredity not mentioned. Smoking not mentioned. Had syphilis. Pimple cauterised regularly with Arg. Nit.	Feb. 8. Left half by galv. écraseur applied twice.	On Feb. 12 symptoms of septicæmia, with swollen glands; on 18th blush over elbow; 19th, ankle; later in other situations.	D.	Died Feb. 24 of septicæmia; no abscesses in lungs, but they were both congested.	—	Patient was a soldier and served long in India, Canada, Gibraltar, &c. The tumour on removal proved to be a gumma.
No. 21. M. 64. London. March 27, 1876.	Six weeks ago a pimple on left side, increasing rapidly; very painful.	Raised ulcer, size of shilling; hard; very tender.	Yes, one at left angle of jaw.	No heredity. Smokes habitually clay pipe on left side. Syphilis not mentioned.	March 28. Removed by galv. écraseur through mouth and round base of T.	Very good recovery.	R.	?	?	—
No. 22. M. 64. Buckinghamshire. Feb. 14, 1876.	Four years ago a small round swelling at tip of T.; increasing and causing furrows.	Irregular sloughy mass near tip of T. size of small fig; firm, tender.	None.	No heredity. Smokes habitually. Had syphilis. Chewed tobacco when younger.	March 2. Removal by galv. écraseur through mouth, laryngotomy required for profuse bleeding during écrasement.	On March 3 rapid breathing commenced; no signs of change on auscultation.	D.	Died Mar. 4 of gangrene of lung with abscess.	—	The tumour on removal proved to be a gumma. Pot. Iod. had been given a fair trial in large doses. One of the most rapidly fatal cases. A good deal of blood had entered the air passages during operation.
No. 23. F. 58. Middlesex. March 21, 1876.	Six weeks ago treated for epithelial growth of left side; floor of mouth cauterised.	Four weeks. Hard firm lump size of hazel-nut quarter inch to left of middle line, nearly reaches tip. Ulcer left under surface size of split-pea.	Yes, one under chin.	No heredity. Smoker (?) Syphilis not mentioned.	March 22. Galv. écraseur through mouth; T. first cleared by cutting, greater part of left half being removed.	Great fœtor. April 2, profuse arterial bleeding from stump stopped by Fr. Perch.; after this good recovery.	R.	?	?	There were spots of exuberant granulations on stump which were suspicious on discharge from hospital.
No. 24. M. 58. Wales. Aug. 24, 1876.	Eighteen months' lump under T.; became an open sore on treatment with caustics.	Oval hard ulcer size of bean at frænum; T. healthy; not much pain.	Yes, one at hyoid bone on left side.	No heredity. Smoking not mentioned. No syphilis. No history of local irritation.	Sept. 6. Jaw divided in mid-line; T. cleared with knife and then removed with galv. écraseur.	On Sept. 13 hæmorrhage to four oz.; then bronchitis was noticed with dyspnœa, which was followed rapidly by cyanosis.	D.	Died Sept. 15 of intense broncho-pneumonia, with extremely fœtid secretions.	—	The patient felt so well three days after operation that he wanted to get up.
No. 25. M. 55. Suffolk. Oct. 20, 1876.	Seven months ago soreness on left side of T., preceded by enlargement of gland.	Firm papillated growth reaches from frænum to last molar on left side; T. healthy.	Yes, one at left angle of jaw.	Heredity not mentioned. Smokes habitually. Syphilis not mentioned.	Oct. 31. Removed by scissors from mouth as far as possible; the bleeding was stopped with actual cautery.	Good recovery.	R.	?	?	—
No. 26. M. 65. Hampshire. Oct. 15, 1877.	Three and a half months ago.	A ragged fissure quarter inch deep on left side of dorsum just behind the middle; around this much induration and some ulceration.	Yes, one at angle of jaw.	No heredity. Smokes habitually. Syphilis not mentioned. No irritation from teeth.	Oct. 16. Wire écraseur from mouth around base of T., the anterior attachments being cut with scissors.	No bleeding; cough troublesome; otherwise good recovery.	R.	?	Gland at angle of jaw still enlarged on leaving hospital.	—

No. Sex. Age. Abode. Date of admission	First evidence of disease, when and where noticed	Present state of primary disease. Pain	Any glands enlarged, and where	Ætiological data. 1. Heredity. 2. Smoking. 3. Syphilis. 4. Local irritation. 5. Leucoplakia. 6. Indigestion, &c.	Date and mode of operation	Course and after treatment	Immediate result	Date and cause of death	Ultimate result	Remarks
No. 27. M. 55. London. Feb. 20, 1877.	Seven years ago a lump, size of hazel-nut, removed from T.; ulcers since; twelve months ago ulcer on right side.	Deep irregular fissure in right side of dorsum with ulcerated border. T. is fixed in mouth; also a round swelling in left side of T. Pain and salivation.	Yes, one at each angle of jaw with others along ramus.	No heredity. Smoking not mentioned. Had syphilis. Teeth said to have irritated the T.	Feb. 21. Galv. écraseur to sever sublingual tissues and body of T.; scissors to take away some parts of growth left behind in stump.	Cough, troublesome second day; bleeding on fifth day stopped by actual cautery.	R.	?	Returned ten days after discharge with recurrence in floor of mouth and glands.	Left hospital with signs of recurrence.
No. 28. M. (?) Haggerston. Aug. 15, 1877.	Two years ago soreness on right side.	Extensive ulcer on right side from tip to root, and running on to floor, where T. is fixed.	Yes, one very large and hard.	No heredity. Smoking not mentioned. Syphilis not mentioned.	None attempted; disease too far advanced.	—	—	?	?	Pain and salivation great, much emaciation.
No. 29. M. 46. London. May 3, 1877.	Fourteen years ago a small pimple; this began to spread seven years ago.	Ulcer on right side.	Yes, very large at angle of jaws and sterno-mastoid.	No heredity. Smokes habitually. Had syphilis. Great drinker.	None attempted: disease too far advanced.	—	—	?	?	Pain very severe.
No. 30. M. 50. Gloucestershire. Aug. 27, 1877.	Seven months; 'a few small pimples noticed before.'	Large irregular cavity in mid. two-thirds of left dorsum; also ulceration on right border. T. fixed.	Yes, many along sterno-mastoid.	Heredity not mentioned. Smoking not mentioned. Had syphilis.	None attempted: disease too far advanced.	—	—	?	?	Pain and fœtor very great.
No. 31. F. 49. Berkshire. March 16, 1877.	Twelve months ago sharp tooth caused an ulcer to form.	Ant, three-quarters of T., enlarged, thick, hard.	Yes, at angle of jaw and above clavicle.	No heredity. Smoking not mentioned. No syphilis. Scraping of T. by sharp tooth.	None attempted: disease too far advanced.	—	—	?	?	—
No. 32. M. 68. Jan. 8, 1877.	Six months ago cut T. on right side with sharp tooth; ulcer formed, did not heal.	Hard, flat, oval ulcer, size of shilling, on right side of dorsum.	Yes, one in neck.	No heredity. Smoking not mentioned. No syphilis.	Jan. 10. Galv. écraseur for right half; portion left behind, snipped away with scissors when the ling. art. was cut, and had to be ligatured.	On 12th a cough began and lasted till death.	D.	Double broncho-pneumonia with grey hepatisation in right base.	—	The original cut on T. was freely cauterised two to three times a week!

No. 33. M. 45. Suffolk. Dec. 19, 1877.	Six months ago pain in T., sore for three months.	Post. two-thirds of left half ulcerated; induration extends from this to right half and to hyoid bone.	Yes, a large mass at angle of jaw.	No heredity. Smokes habitually. No syphilis.	None attempted; disease too far advanced.	—	—	?		Pain severe.
No. 34. M. 33. Lincolnshire. April 10, 1877.	Five months ago a hard nodule in tip; grew painful and was removed eleven weeks ago.	Tip of T. fixed to floor by growth reaching first molar.	Yes, at angle of jaw on right and left.	No heredity. Smokes to excess. Syphilis not stated. Scratched T. with clay pipe.	April 14. Wire écraseur through a modified Regnoli incision; ant. third of T. removed.	Good recovery.	R	—	—	The écraseur cut through T. in thirty-seven minutes; only a little oozing of blood.
No. 35. M. 42. Buckinghamshire. March 13, 1878.	Five months ago, sore on T.	Hollow ulcer, size of shilling, on right side of under surface at first and second molar tooth, hard; a good deal of continuous pain.	None when admitted first, later several were involved.	Heredity, yes. Smokes to excess. Syphilis doubtful. Holds pipe between bicuspid and first molar teeth.	March 15. Portion of T. containing the ulcer removed with scissors; free bleeding stopped with actual cautery.	Good recovery; left hospital March 23; wound nearly healed.	R.	?	Recurrence noticed after leaving hospital, May 8. Surface of growth destroyed with Paquelin's cautery; wound healed; gland left.	The growth was plainly not removed by the second operation, but patient was much relieved for a little. Third operation on July 4 as before, the pain being intense since last, Oct. 10, gustatory nerve divided in usual way. Patient discharged 14th, considerably relieved.
No. 36. M. 65. London. March 13, 1878.	Not stated.	Whole T. indurated, ulcerated on dorsum chiefly on left side; very little pain.	Yes, one under ramus of jaw.	Heredity not mentioned. Smoking not mentioned. Syphilis not mentioned.	March 20. Wire écraseur from mouth round base of T.; had to be re-applied for fragments of growth left behind. The ant. attachments were divided with scissors.	March 24. Complained of difficult breathing, which became intense within a few hours; on 25th became livid, and laryngotomy performed in extremis.	D.	Died March 25, double pneumonia. All the growth had not been removed.	—	—
No. 37. M. 64. Wales. May 22, 1878.	Twelve months ago a small crack on left border, which increased slowly.	Ulcer, size of sixpence, on post. third of dorsum, on left side; hard, slightly painful.	None.	Heredity probable; one sister died, cancer of breast. Never smoked. No syphilis. T. rubs against false teeth.	May 23. Growth removed piecemeal by cutting; bleeding stopped with Paquelin's cautery.	Good recovery; a little bleeding (27th). Mouth washed with Condy's fluid; left hospital June 4.	R.	—	?	Patient relieved by operation, but probably only temporarily.
No. 38. M. 61. Wales. March 16, 1878.	Not stated.	Whole right half of T. destroyed, floor healthy.	None.	Heredity not mentioned. Smoking not mentioned. Syphilis not mentioned.	March 27. Wire écraseur from mouth, the attachments of T. having been cut with scissors.	Good recovery; mouth dressed with Glyc. c. Acid. Carbol.	R.	—	Recurrence probable in stump before leaving hospital.	—

No. Sex. Age. Abode. Date of admission	First evidence of disease, when and where noticed	Present state of primary disease. Pain	Any glands enlarged, and where	Etiological data. 1. Heredity. 2. Smoking. 3. Syphilis. 4. Local irritation. 5. Leucoplakia. 6. Indigestion, &c.	Date and mode of operation	Course and after-treatment	Immediate result	Date and cause of death	Ultimate result	Remarks
No. 39. M. 49. Surrey. April 2, 1878.	—	Ant. half of T. on left side occupied on its border by an ulcer running beneath tip, size of florin; no pain.	Yes, slight under jaw.	Heredity not mentioned. Smokes habitually. No syphilis.	Preliminary tracheotomy; division of lip and jaw; tongue removed at base with scalpel in two halves; not much hæmorrhage.	Good recovery; mouth drained by silver tube over hyoid bone; washed with Condy; mouth and nose closed with pads; tracheal opening free.	R.	—	Alive six months later, then lost sight of.	Part of the ends of divided jaw necrosed after he left hospital, but health appeared good for some months until lost sight of.
No. 40. M. 72. Wales. Jan. 21, 1879.	Six months ago gland on left side enlarged, then noticed hardness under tip of T.	Ragged ulcer, size of shilling, under tip, with hard edges and much induration around in floor of mouth and jaw.	Yes, one at left angle of jaw.	No heredity. No smoking. Syphilis not mentioned. No local irritation.	None attempted; disease too far advanced.	—	—	?	?	—
No. 41. M. 49. London. April 7, 1879.	Three years ago 'a sore place' on left side, growing slowly until he bit his T. six months ago; since then rapid increase.	Narrow ulcer on left border from root to tip, shallow, and appears to be healing; little hardness around.	None.	No heredity. Smokes habitually. No syphilis. Irritation from decayed tooth. Bite of tongue later. Leucoplakia lingualis and buccalis also, six years.	April 9. Preliminary tracheotomy, supra-hyoid puncture; tongue split, then removed in halves by wire écraseur.	Cannula kept in trachea; nose and mouth closed with pad of wool, washed out with Condy's fluid; mouth drained from supra-hyoid wound by silver tube.	R.	Died Aug. 13, 1879, of recurrence in glands of neck with general cancerous marasmus.	Recurrence. Death on Aug. 13, 1879.	The patient recovered well without any lung trouble, the mouth draining freely.
No. 42. M. 52. Devon. Sept. 24, 1879.	Twelve months ago a 'hard place on dorsum' size of threepenny piece, but little pain.	Long ulcer on right edge of T. extending to three-quarters of an inch of tip and three-quarters of an inch wide, with induration around.	None.	No heredity. Smokes in moderation. No syphilis. No local irritation.	Oct. 9. Tongue split; two-thirds of right half removed from mouth by wire écraseur; no hæmorrhage.	Fed with a tube. Good recovery.	R.	?	Recurrence before leaving hospital in stump.	—
No. 43. F. 26. London. April 20, 1879.	Nine months ago, hard red lump on back part of right edge, soon ulcerated, with aching pain; ulcer cauterised.	Large, irregular, hard ulcer on right half of dorsum, one and a half inches behind tip.	Yes, one above hyoid.	No heredity. Smoking, no. Syphilis doubtful.	April 23. Preliminary tracheotomy; tongue split; right half removed by wire écraseur from supra-hyoid puncture; left, by knife through mouth.	Patient compelled to breathe by tracheal hole by pads on nose and mouth; latter drained by supra-hyoid wound into a basin of carbolic water.	R.	—	Recurrence. Died Mar. 8, 1880.	Patient made a good recovery, but a gland over hyoid enlarged soon and was removed later; some time after another operation was performed at another hospital.

No. 44. M. 44. London. Oct. 6, 1879.	Six months ago slight sore, growing rapidly worse.	Raised ulcer on left side from about one inch from tip to pillar of fauces, induration of left half of T. only.	Yes, at left angle of jaw.	No heredity. Smoking not mentioned. Syphilis (?). Sharp tooth opposite ulcer. Leucoplakia buccalis.	Oct. 16. Preliminary laryngotomy; wire écraseur from mouth round base of T.	Good recovery on the whole, though there was much swelling of the glands for a time, and pain.	R.	—	—	The line of removal did not quite clear the growth
No. 45. F. 31. London. Sept. 26, 1879.	Three years ago cut T. with sharp tooth, wound cauterised, ulcer grew fast.	Whole T. quite gone; floor of mouth filled with epitheliomatous growth.	Yes, under jaw and in front of sterno-mastoid.	No heredity. Smoking not mentioned. Syphilis not mentioned. Scraping of sharp tooth.	None attempted; disease too far advanced.	—	—	?	?	The growth involved the skin beneath the chin and had begun to break through before leaving hospital.
No. 46. M. 43. Kent. Dec. 4, 1879.	Three months ago swelling of T. noticed, attributed to bites during epileptic fits; constant pain.	Raised, hard ulcer on right side one inch and a half from tip, half-inch from mid. line, extends to pillar of fauces; great induration and tenderness.	None.	No heredity. Smoking not mentioned. No syphilis. Frequent bites of T.	Dec. 9. Preliminary tracheotomy; wire écraseur by suprahyoid puncture; right half removed.	Mouth drained by silver tube in floor with rubber tube attached. Overdose of morphia third day, requiring artificial respiration and restoratives; after this went on well but was troublesome; finally developed pyæmia.	D.	Died Feb. 2, 1880. Pyæmia with abscess over spleen and infarcts in kidneys; lungs not diseased.	No trace of secondary growths found, P.M.	This was one of the most unmanageable of patients and always ill-tempered. The tracheal wound was much disturbed during artificial respiration.
No. 47. M. 38. Portsmouth. Nov. 5, 1880.	Three months ago hard sore on left side from chafing of sharp tooth; growing steadily.	Irregular shallow ulcer made up of several smaller sores on left side size of florin; floor free; no pain; much salivation.	Yes, under ramus of jaw.	No heredity. Smokes to excess. No syphilis. Irritation of a sharp tooth.	November 9. Wire écraseurs from the mouth; a piece left behind was ligatured. Left half removed.	Good recovery; wound washed with Condy's fluid.	R.	Died Jan. 7, 1881, of generalisation of growth and marasmus.	Recurrence in stump suspicious before leaving; glands enlarging more.	
No. 48. M. 56. London. Jan. 15, 1880.	Three and a half months ago pricking pain in left border, ulcer a month later.	Deep narrow ulcer on under surface on left side from frænum, one inch backwards, much induration; shooting pain.	Yes, several along sterno-mastoid, and at angle of jaw.	No heredity. Smoking not mentioned. No syphilis. Occasional sores under T., probably dyspeptic.	None attempted; disease too far advanced. Discharged Jan. 17.		—	Died Feb. 21, 1881, of cancerous marasmus; nodules of new growth in internal organs.	—	Re-admitted two days before death.
No. 49. M. 49. Dover. Sept. 10, 1880.	Seven months ago, after a bad sore throat, pimple appeared on right side far back; four times cauterised.	Small ulcer on right dorsum; induration of almost the whole of right side; T. fixed; pain and salivation bad.	Yes, many under ramus of jaw.	No heredity. Smoking not mentioned. Had syphilis.	Sept. 15. T. split, one half dissected free with scissors and removed with wire écraseur at base; profuse bleeding requiring laryngotomy.	Very good recovery; suspicious induration about stump on leaving hospital.	R.	—	Recurrence probable before leaving hospital. Glands then still enlarged.	—

No. Sex. Age. Abode. Date of admission	First evidence of disease, when and where noticed	Present state of primary disease. Pain	Any glands enlarged, and where	Ætiological data. 1. Heredity. 2. Smoking. 3. Syphilis. 4. Local irritation. 5. Leucoplakia. 6. Indigestion, &c.	Date and mode of operation	Course and after treatment	Immediate result	Date and cause of death	Ultimate result	Remarks
No. 50. M. 50. London. March 13, 1880.	Nine months ago a small vesicle on right side which soon became a small ulcer.	Ragged ulcer from pillar of fauces to near tip on right side; but little pain; (?) leucoplakia.	Yes, one at hyoid bone slightly felt.	No heredity. Smokes to excess. No syphilis. Sharp end to pipe stem.	March 17. T. split, diseased half freed with scissors, then removed with wire écraseur from mouth; growth not completely removed.	Very good recovery; mouth washed with Condy's fluid. On April 2 a small recurrent nodule was cut away with scissors from stump.	R.	?	Recurrence in pillar of fauces and stump. Growth same character as before. Glands enlarged.	A second operation was done for recurrence on July 10; growth removed in part by Paquelin's cautery; glands grew still more, and growth occurred later in stump.
No. 51. M. 49. London. April 20, 1880.	Two months ago a small ulcer on left border, growing fast in all directions.	Large ragged ulcer on left side and floor; not much pain.	Not stated.	Heredity not mentioned. Smokes to excess; clay pipe. Had syphilis. Cook by trade (Italian).	None attempted, as patient was suffering from well-marked diabetes mellitus.	—	—	?	?	There was profuse hæmorrhage from the ulcer while in hospital and on other occasions.
No. 52. M. 59. London. Dec. 31, 1879.	Seven months ago small lump on right side posteriorly, growing fast.	Large oval ulcer on right side of dorsum and touching pillar of fauces. No pain.	Yes, several under jaw and in neck.	No data given except chill and sore throat twelve months ago.	None attempted, the patient being in advanced phthisis.	Slowly sank.	—	Died April 26, 1880, of phthisis and cancer marasmus combined.	—	—
No. 53. F. 78. Dec. 17, 1880.	Twelve months ago a sore on left side of tip.	Whole tip and ant. part ulcerated away.	Yes, several under jaw behind and in front of sterno-mastoid.	No data given.	None attempted, disease too far advanced. Discharged Dec. 18, 1880.	—	—	?	?	—
No. 54. M. 30. London. Sept. 26, 1880.	Nine months ago small ulcer on left side, probably syphilitic, which grew into present form.	Ragged sore quarter of an inch deep on left border, large, with much induration around.	Yes, two at both angles of jaw.	Heredity not mentioned. Smoking not mentioned. Had syphilis.	None; patient left by his own desire on Dec. 29.	Severe bleeding just before and during stay in hospital.	—	?	?	This looks like one of those cases where a syphilitic ulcer develops into epithelioma.
No. 55. M. 48. Surrey. Oct. 25. 1881.	Not mentioned.	Ulcer at left border from pillars of fauces forwards. T. fixed; floor much indurated; jaws fixed; tonsil hard. Pain very severe.	Yes, many at angle of jaw.	No heredity. Smoking not mentioned. Syphilis not mentioned.	Oct. 26. T. split with scalpel. Wire écraseur over left half, which left growth behind; reapplied for remainder, part of which was cut away with scissors.	Had cough for a day or two, but made otherwise a good recovery.	R.	—	Recurrence in stump and tonsil before leaving hospital.	The growth was plainly only removed in part. The amount of fixation of the jaw was very remarkable in this case.

No. 56. M. 60. London. Oct. 5, 1881.	Six months ago a small hard spot on centre of left half, which grew slowly to present condition.	A long narrow fissure one inch and a half, reaching from tip along left border of T., a small ulcer on under surface on left side. Pain moderate.	Yes, under ramus of jaw on both sides.	No heredity. Smoking not mentioned. Had syphilis.	Oct. 5. Attachments of T. cut round with scissors, wire écraseur placed round base, and greater part of organ removed. Left lingual art. spouted and was tied.	Good recovery; discharged Oct. 15; glands still enlarged; no obvious recurrence in stump.	R.	?	Nov. 2, 1881, glands removed, but not all. On leaving hospital there was plainly infiltration of several remaining.	Patient was plainly thinner on discharge, and extra glands were enlarging. The floor of mouth was healed but hard.
No. 57. M. 60. London. Oct. 17, 1881.	Two years ago a small sore spot on middle of dorsum, growing to present size.	Long ragged ulcer along left border, from tip to base almost; floor of mouth is healthy; rather painful.	Yes, under ramus and at carotid triangle on both sides.	No heredity. Smokes habitually. Syphilis not mentioned.	Oct 19. T. cleared with scissors, wire écraseur over base which yielded some blood on division. Paquelin's cautery applied; bleeding checked.	A little bleeding on 24th; bronchitis.	R.	?	?	—
No. 58. M. 62. Hertfordshire. April 4, 1881.	Four months ago blisters on tongue and mouth; later, a small ulcer seen where cancer now is; grew steadily.	Shallow ulcer $\frac{3}{4} \times \frac{1}{2}$ in. on right side clear of mid-line and of floor; hardness well circumscribed, no pain or much salivation.	None.	Heredity (?). Smoking not mentioned. No syphilis. No local irritation.	May 4. Incision three-quarters of an inch long over hyoid; wire écraseur introduced through this and round base of right half, being passed through centre of T. Free bleeding; tracheotomy required. T. then split with knife, and operation concluded.	Sponge left in pharynx first day. Tracheal wound left open for breathing for about ten days, then slowly closed. Had a good deal of cough, but made a good recovery, being out of bed on and from seventh day. Discharged June 3.	R.	Died Nov. 5, 1881, of cancer marasmus from recurrence in glands of neck.	Recurrence in carotid glands soon after leaving hospital.	Patient returned to have glands removed soon after; but on making an incision down on them they were found to be too firmly seated for safe enucleation.
No. 59. M. 49. Berkshire. March 29, 1881.	Three months ago small pimple on left side of tip; others underneath.	Large, shallow, hard, irregular ulcer over whole left half. T. bound down to floor; pain constant.	Yes, many under left ramus and on side of neck.	No heredity. Smokes habitually. Syphilis doubtful. Clay pipe; sore tongue often.	None attempted; disease too far advanced.	—		?	?	Cachexia well marked.
No. 60. M. 45. London. August 29, 1881.	Eight months ago sore on right side of back of T.; grew steadily; T. became fixed.	Ulcer on right border which is fixed to floor and much indurated; excess of saliva. Pain sharp.	Yes, on both sides under jaw, most on right.	No heredity. Smokes habitually. No syphilis. Clay pipe on right side ten years; no mouthpiece.	None; disease too far advanced.	—	—	Died Dec. 1, 1881, of starvation, the swollen glands having for some time prevented swallowing. Septic pneumonia found prevalent, with fœtid abscess in left lung.	—	Patient had been seized with violent dyspnœa on Sept. 17, which lasted some days.

shown to be 26 (one of the author's cases, No. 43, which died afterwards of recurrence), and over 80, and between these the cases arrange themselves as below :—

	20–30	30–40	40–50	50–60	60–70	70–80	80–90	Total
Clarke	1	6	12	11	7	2	—	39
Von Winniwarter, from Billroth's Klinik	2	8	13	17	6	—	—	46
Author, from University College Hospital	1	6	21	17	12	3	—	60
Woelfler, from Billroth's Klinik	—	6	13	19	9	1	—	48
Rose, of Zürich	—	1	2	1	3	—	—	7
Paget	3	5	8	8	3	2	1	30
Morris, from Middlesex Hospital	1	3	19	21	12	4	—	60
	8	35	88	94	52	12	1	290

The bulk of the cases, it will be seen, lie between the ages 40 and 60, or on closer examination, between 45 and 55.

The next question is, the relative frequency of epithelioma of the tongue in the two sexes ; and here the same tables may be combined again, giving the following results :—

	Males	Females	Total
Clarke	28	11	39
Von Winniwarter, from Billroth's Klinik	43	3	46
Author, from University College Hospital	55	5	60
Rose	6	3	9
Paget	19	11	30
Woelfler, from Billroth's Klinik	48	—	48
Morris, from Middlesex Hospital	48	13	61
	247	46	293

Thus, on a total of nearly three hundred carefully recorded cases, we only find 15·6 per cent. of females to 84·3 per cent. of males. It is worth noting, however, that in the Serafimer Hospital in Stockholm, out of 21 cases of cancer of the tongue tabulated by Berg,[1] there were 11 females affected.

The reason for this great frequency of epithelioma of the tongue among males, as compared with females, is extremely difficult to account for satisfactorily, but will be apparent to some small extent, perhaps, when we have studied the ætiology of the disease more in detail. But it should not be forgotten that, when disease of the breast and uterus are excluded, cancer generally is much more frequent in males than in females. Thus, combining Paget's, Sibley's, and von Winniwarter's tables of cancer in all parts, we have a total of 1,568 cases, of which 1,006 were females and 562 males ; but, subtracting 794 cancers of the breast and uterus from these, there remain only 212 females affected, against 562 males.

In considering the pathological and clinical materials now at our disposal, there appears to be little room for doubt that epithelioma of the tongue is in some way connected with local chronic irritation of one form or another. And that this may produce the disease without any hereditary cancerous taint appears equally clear. Thus von Winniwarter states that ' inheritance is excluded in almost all his cases.' In my own collection the evidence on this question is as follows—family taint is distinctly negatived in 20 cases, is simply negatived in 22, is only positive in 1, is doubtful in 4, and no statement on the point is made in the rest. These figures speak for themselves. The conclusions they point to are strengthened by the results of an analysis of Mr. Morris's collection of 61 cases. Of 29 of these, in which a note is furnished on this point, cancerous taint is negatived in 22, is doubtful in

[1] *Studier Öfver Tungkraftan.* Stockholm, 1881, p. 4.

5, and is only distinct in 2. In the face of such facts it would appear as though the occurrence of cancer in the families of those who have the disease in the tongue was little more than a coincidence.

As to the actual forms of local irritation which appear to give rise to the disease, they are many, as might be expected when we consider the variety of substances taken into the mouth, and the injuries to which the tongue is liable. Among those most commonly met with are such as are due to bites repeated at one spot or other, the chafing of a decayed or false tooth, or one constantly covered with tartar, the rubbing of the rough end of a pipe stem, &c.; then the habitual use of over-stimulating foods, fluid or solid, such as ardent spirits, spices, onions, garlic, or, the chewing of tobacco. Again, burns on the tongue are dangerous in the same way—a very striking illustration of this being given by von Winniwarter (*loc. cit.* p. 209). Here the origin of the disease was a small ulcer, the result of a burn made by the application of the lighted end of a cigar to the tongue. But, above all, that irritation due to habitual and excessive smoking is dangerous, not only on account of the constant stream of hot vapour upon one part of the tongue, but also from the acrid products of dry distillation present in tobacco smoke. Of these, carbonate and acetate of ammonia, carbolic and acetic acids, which have been shown by Professor Ludwig,[1] after very careful analysis, to be present in relatively large quantity, are probably particularly injurious. The prolonged action of these upon the tongue is such as to give rise in certain persons to a species of chronic superficial glossitis, which has already been specially described under the name of leucoplakia lingualis (p. 562), or ichthyosis glossæ. This condition may last for years without producing any ill effect, but not unfrequently, on the addition of some slight external irritant, will commence to undergo epitheliomatous change. Thus the latter has been known to start at a spot of the tongue from which a patient had been in the habit of peeling or shaving off the thickened leucoplakial epithelium due to the chronic glossitis caused as above (von Winniwarter, Case 9, Table 13). In other cases, a bite or other injury to the 'smoker's tongue' has been the starting-point of the new growth. But many cases are recorded in which epithelioma has commenced in the smoker's or leucoplakial tongue, without any known injury in addition. How far chronic gastric irritation may tend to produce irritation of the superficial layers of the tongue to such an extent to give rise to a condition resembling, if not identical with, that produced by smoking is still uncertain. There seems good reason to suppose, however, from the evidence of some recorded cases (Möller [2]), that this cause, too, may operate in the same direction. But that smoking is one of the most fertile sources of epithelioma of the tongue seems clear not only from its manifest ætiological relation to leucoplakia, which so frequently runs on to cancer, but also from the fact that many of those who are affected with the latter, without any previous leucoplakia, have been excessive smokers, and attribute the commencement of their disease to the soreness produced by this. Among the 60 cases I have tabulated it will be seen that 29 are reported as smokers, and of these that 10 indulged in the habit to excess, and 18 moderately or habitually; 6 did not smoke at all. No statement on this point is made with regard to the rest. In the Middlesex Hospital table, notes are not forthcoming on this point in a sufficient number of cases to be taken in evidence. Still, many of the patients are reported as smokers, excessive or moderate. Of course it will not be argued that every man who smokes runs a risk of developing lingual cancer; for of the thousands who do so, probably only a small proportion suffer from this disease. But that many individuals would never have had the disease if they had not indulged in the habit to excess appears very probable indeed. It may be that here we have some of the reasons, at all events, why men are so much more liable to cancer of the tongue than women, as shown above—namely, that the latter do not so commonly smoke, chew tobacco, or drink ardent spirits, or generally use the more stimulating forms of food. On the other hand, it is stated by von Winniwarter that in the East, and in those places where women also indulge in this habit of smoking, epithelioma of the tongue is as rare among them as among ourselves. It appears possible, however, that this

[1] *Archiv f. klin. Chir.* Bd. xx. p. 363. [2] *Deutsche Klinik*, 1851, No. 26, p. 273.

disease may be more frequent in the weaker sex in this country than it appears to be in Germany. At least this would appear from a glance at the above table (p. 590) where an addition of the figures in the four English collections gives, out of 190 cases, 150 males to 40 females, or 79·0 per cent. to 20·9 respectively; while the three German series combined give 97 males to 6 females in 103 cases, or 94·1 per cent. of the former to 5·8 of the latter.

As to the question whether syphilis generally predisposes to epithelioma of the tongue it may be answered in the negative. Among von Winniwarter's 46 cases, 3 had been syphilised, and 4 had had specific sores without any constitutional troubles. Of our own 60 cases, 12 had clearly had the disease, 3 were doubtfully affected, and of 22 it is reported that there was plainly no evidence of its existence; in 24 there is no note on this point. In the 61 cases from the Middlesex Hospital, included in Mr. Morris's table, 13 are stated as having had syphilis, in 9 it is distinctly negatived, in 1 it is doubtful, and in 38 there is no note on the subject.

Instances, however, are met with occasionally where an ulcer caused by the breaking down of a gumma has gradually developed an unmistakable epitheliomatous character. This was well seen in at least one of our cases at University College Hospital, and the growth had to be removed. Here it is probable that the chronic syphilitic ulcer only acted as any other irritant upon a person predisposed to cancer in one way or another.

Physical characters.—The physical characters of epithelioma of the tongue now claim attention. The actual new growth itself, when fully developed, does not differ histologically in any important particular from squamous epithelial cancer of other parts, this being the form almost invariably met with here. We find lobulated prolongations of epithelial growths downwards into the deeper tissues and the same 'cell nests' as elsewhere. Nevertheless there are clinically, at least as far as my experience goes, four different initial forms of the affection which may revert sooner or later to the common type. These are: (1) the small, hard, sharply defined pimple or knot, a little raised perhaps, but smooth on the surface, first observed just beneath the coverings, but in the substance of an otherwise apparently healthy tongue, usually at one side or actually on its border; (2) the small abrasion or crack, more likely to be on the upper surface of the organ, starting without any previous induration, but very often from a blister; (3) the prominent or papillomatous form, looking benign at first, but developing into typical epithelioma later, seated as a rule on the dorsum of the tongue somewhat to one side and well back; then (4) a less frequent form, namely, a general rawness over a considerable area of the surface of the organ, with but slight induration at first, or, indeed, until the condition has lasted for a long time. This is a form which is often associated with leucoplakia. The two first of these varieties are the most rapid in their development into the deeper and more dangerous forms of the disease; the two latter are slower in their advance, and perhaps a little less liable to implicate the glands early. On this point our table speaks with tolerable clearness. Taking this implication of the neighbouring glands as a fair measure of the danger of any given growth, I find that out of 13 of our own table in which it is distinctly stated that the glands were not enlarged, 8 of the ulcers belonged to the large or medium sized superficial variety, while only 3 were of the large deep kind. And, on the other hand, out of 42 in which it is noted that the glands were implicated, only 11 were of the large shallow variety, while 26 were of the large deep kind, and 5 were small and deep, there being no glandular induration with the small shallow ulcers. The probability, then, of glandular infiltration appears to depend rather upon the depth of the morbid deposit than upon its superficial extent; in other words, we often see a large superficial ulcer with no glandular enlargement, while we meet with many small deep deposits with well-marked infiltration of the lymphatics. This also appears to have been von Winniwarter's experience generally, though he has not reduced it to figures, and Mr. Morris's tables afford grounds for similar conclusions, though here, too, a numerical estimate is difficult. In fact, we are always met with a great difficulty in supporting such conclusions by rigid statistical data, owing to the different methods of recording cases adopted by

various writers. But a careful study of large numbers of published cases, as well as actual examination of at least forty or fifty during life or after death, has satisfied me as to their general accuracy.

Familiarity, then, with these several initial forms of epithelioma in their earliest stage is of vital importance in view of speedy diagnosis and prognosis.

Seat of neoplasm.—The question as to what part of the tongue is most frequently the seat of cancer now suggests itself, and is of particular interest as furnishing some indirect evidence on the origin of the disease from local irritation. It is perhaps best answered by assimilating as far as possible the deductions on this point from carefully arranged tables, such as those furnished by von Winniwarter and Woelfler, and so securing as large a total of accurately recorded cases to judge from as possible. This is done in the following tables :—

	Von Winniwarter	Woelfler
Right upper surface	12	—
Left upper surface	6	—
Right border	5	15
Left border	9	9
Under surface	8	6
Tip of tongue	3	6
The dorsum	3	2
The frænum	—	6
The floor of mouth	—	4
	46	48

The mode of classification of the beginning of the cancer in the tongue adopted by Mr. Morris in his table being more in harmony with the classification I had already given in the text before I had the advantage of hearing his paper, I have thought it better to compare the figures from our own table with his material collected in a neighbouring hospital, than with those of the German authors above, which are arranged somewhat differently. I have, however, examined in addition into one small point, noticed specially in the German lists, as far as my own table goes—namely, the relative frequency of disease in the two sides of the tongue. Here, too, then, the right side is found to be more frequently affected than the left, but the difference is only slight, being as 21 to 18 out of 39 cases in which the point is noted. But other points of much more importance as regards the origin of the disease are given in the following table, and as the need of study of the disease as early and as closely as possible is urgent, I have given them rather in detail. The table is by no means perfect, but it indicates some matters well worthy of closer study. The earliest trace of the disease where a record has been kept has been noticed as follows :—

	Morris	Author
1. As a small fissure or crack	—	—
a. On the dorsum	4	—
b. „ tip	4	1
c. „ edge	20	3
2. As a pimple or small tubercle	—	3
a. On the edge	5	13
b. „ under surface	1	—
c. „ under surface and edge	1	1
3. As a nodule in the substance	5	5
4. As a blister	3	2
5. As an ulcer spreading from the floor of the mouth	3	2
6. As an ulcer spreading from the pillar of the fauces	1	—
7. As a general soreness or feeling of rawness, with fixation of the tongue	2	8
8. As an ulcer spreading quickly from wound or other cause	—	18
	49	56

The most remarkable fact deducible from these combined figures is the large proportion of cases in which the disease had its starting-point on one or other border of the tongue, equalling at least 41 in 105 cases. I may mention further that, although from the German collection and in our own the right side appears to have been more frequently attacked than the left, this is not the case in Mr. Morris's list, which I

have examined carefully with a view to this point. Here the disease started exactly the same number of times on the right as on the left, in 32 instances. In our own tables, it will be remembered, the two sides are thus represented—right 21, left 18.

Another point worth noticing is the large number of cases in which the disease commenced as a fissure or crack, or as a pimple or tubercle. And there is good reason to suppose that in many of those set down as first noticed in the form of an ulcer, the disease really started in one or other of these ways. This ought to teach us to regard all indolent fissures or pimples on the tongue (between the ages of 30 and 50 especially) with much suspicion, and to be ready to excise them freely on the first clear sign of their increase with induration. Many valuable lives would be saved if this were more attended to; it would matter very little if occasionally a small harmless pimple or fissure were excised, the operation required in such a case being very simple.

Again, the shallow, patchy, often multiple, slow-growing ulcers, which spring from one form of leucoplakia, are found in many cases in our table, and show very distinctive characters.

Finally, it may be mentioned that epithelioma, starting from an originally benign papilloma, is hardly represented in the above tables. And yet I have seen several apparently with this history. At the present moment I have one such under my care with now hopelessly advanced disease, both in the tongue and glands of the neck. This patient states clearly that seventeen years ago he distinctly had a growth, which, from his description, must have been a papilloma on his tongue. This was partially removed by a medical man, and grew again somewhat. Two months ago one of my colleagues removed a great part of his tongue for well-marked epithelioma which had started at the stump of the papilloma, but the man is now dying of recurrence.

Unfortunately, the ordinary practitioner often does not see these tongue cases in the early stage—indeed not, as a rule, until very considerable ulceration has taken place. And not until the terribly fatal error of delay in any case of the kind is more generally recognised will this cease to be so. Doubtless there is an improvement in this direction of late years, but still only too many patients present themselves to the operator in a state almost, if not quite, unfit, from the extent of the disease, for any interference. Thus, in our own series of 60 cases, 22 were unoperated upon, of which nearly all are expressly stated to have been unfit for interference of any kind.

In the Middlesex Hospital list of 61 cases, too, there is even a larger proportion unoperated on—namely, 32 to 29 in which excision was practised. Now, if these 54 patients from the combined lists had been dealt with by excision and had survived immediate risks, there would have been an average gain of life to each of 6·1 months, as we shall see further on, making up a total of over 27 years of human existence saved, or over 50 years to every 100 patients, to say nothing of relief of suffering and possible immunity from recurrence.

It is speculation in this direction which has led some Continental surgeons to perform as a matter of course very extensive operations on patients whose disease would in this country be held by most to be too far advanced to justify extirpation. Thus, in Professor Billroth's Klinik out of 94 cases only 7 were not operated on, the remainder in many cases undergoing the most severe operations. As might be expected, this has increased the mortality in that particular Klinik, but at the same time many lives have been prolonged and rendered tolerable which would otherwise have terminated miserably within a short period.

What all must hope for, then, is a more thorough acquaintance with the earliest manifestations of epithelioma in the tongue, and a fuller knowledge among the public of the gravity of the condition and of the fatality of the error of neglecting any suspicious appearance in the organ, even for a day.

Under whichever of the three forms mentioned above the disease makes its first appearance, it usually soon reverts to one tolerably characteristic type of ulcer. This is usually seated more on one side of the tongue than the other, and may spread over its border on to the floor of the mouth; it is irregular in outline, abrupt at the margin, which is much indurated and usually nodular, and a little raised and even

everted. The surface of this ulcer is usually very rugged, lumpy red granulations alternating with small whitish shreds of broken-down material. Sometimes the tongue is puckered around and bound down by firm material to the floor of the mouth. In advanced cases the whole of the tongue may be in great part destroyed, with more or less of the floor of the mouth, and even with part of the jaw. Again, the starting point of the growth may be the floor of the mouth or under surface of the tongue, the organ itself being only secondarily involved. Here the glands are almost certain to be early infiltrated. Finally, there are cases in which the initial lesion appears to remain stationary or even heal up, while a hard round knot of epithelioma forms in the substance of the tongue, where it may attain considerable size before actually breaking down upon the surface. If this mass develop at the side of the organ towards the floor of the mouth, the tongue may be more or less fixed and bound down.

The only condition with which this is likely to be confounded is that produced by the breaking down of gummatous or tubercular deposits. Gumma of the tongue, however, is usually seated more towards the body of the organ than in the border; it is generally present for a considerable time in the form of a smooth elastic lump, not affecting the superficial layers of the organ, and wanting the rugged hardness of the epitheliomatous nodule; it then softens, opens on the surface, and leaves a ragged cavity, at the bottom of which is a quantity of greyish slough. This cavity is not surrounded by induration of the tissues as in cancer, and its borders are not hard and everted. The glands along the margin of the jaw are not affected. Finally, a week or ten days' use of free doses of iodide of potassium will reduce it in size as a rule, while no effect will be produced on epithelioma.

The tubercular ulcer of the tongue is very rare as compared with the gummatous or cancerous. It is, as a rule, seated far back on the tongue, is often multiple, and is mostly, too, associated with similar ulcers on the palate or fauces. It is usually found as a sharp-cut cavity-covered with a creamy white curdy deposit; it has a bright red margin but little indurated and not everted. Finally it is, as met with, mostly associated with other evidences of phthisis, and it will probably improve under the use of cod-liver oil and other tonics, with the application of Tr. Iodine to the ulcer.

All these forms of cancerous disease give rise to much suffering. They interfere with mastication, and, as a consequence, patients often prefer to confine themselves to soft foods or fluids for months, rather than suffer the torture of chewing and swallowing solid matters. Again, these ulcers give rise to much fœtor and discharge, interfering greatly with the patient's comfort, and producing gastric and pulmonary disturbance in many cases. And not only do they complain of the discharge from the ulcer, but also in many cases of profuse salivation, necessitating constant spitting, which, as the secretions of the mouth are very foul, is most distressing. But, worse than all this, many unfortunate patients with lingual cancer suffer the most intolerable pain. This is not invariably the case where the disease is moderately advanced, some suffering but little then. But, when fully developed, few escape the greatest torture. This is usually felt, not only in the ulcer itself during eating, but constantly at other times in the ear, occiput, or radiating over the temporal region. When this pain is at its worst everything else is forgotten, and nothing but the administration of large doses of morphia, or division of the gustatory nerve (p. 618) or excision of the tongue, has any control over it.

Operations on the Tongue.

We have now to consider what are the resources of surgery in dealing with these diseases described above. These naturally divide themselves into operations for the removal of portions of the organ, and palliative measures for rendering the patient's condition as little miserable as possible where, for any reason, the latter are not undertaken. All allusions here to the various ways of treating cancer of the tongue by caustics, &c., is purposely avoided. The practice cannot be too urgently deprecated. Only too often the surgeon has an opportunity of seeing the fatal mistakes which are still made in thus trifling with a most malignant disease by superficial applications of

this or that. And that moreover at a time when the patient could almost certainly be saved the risks of recurrence by timely excision.

The operations for the removal of portions of the tongue, which are of comparatively early origin, have become so numerous, and are so variously modified, that even a brief description of all of them would be impossible in a short essay like the present. I shall therefore do no more here than indicate the objects of the most important of the older procedures in a few lines devoted to each, arranged in a table, and shall then endeavour to give a short description of those methods of dealing with cancer of the tongue now most in use.

As to the propriety of operating at all for the removal of cancer of the tongue there can hardly be any doubt at the present day, although there is still a tendency in the minds of some surgeons to regard the operation with little favour. The question turns upon two points.

First, is it possible to rid a patient permanently of his disease who once has cancer of the tongue? This question is answered distinctly in the affirmative, as regards a certain proportion of cases, by statistics given later on (p. 605). But it may be answered with almost equal certainty from the natural history of epithelioma. Surely if there is one species of cancer more than another which remains for a time a purely local affection, it is this; and if there is a position in the body in which it can be isolated with ease, it ought to be the tongue. 'Why then,' it is urged, 'does recurrence take place in the vast majority of cases operated on?' as will be shown presently. The answer is that hitherto either the public has not been aware of the immense gravity of even the smallest trace of cancerous disease of the tongue, or the general diagnostic powers of our profession have not come up to the needs of the case in the early recognition of the disease, or the necessary knowledge that nothing but free and early removal of the part affected will secure a patient from recurrence is not as widely diffused as it ought to be; finally, there is a popular dread of removal of the tongue, based upon the belief that with the loss of part or the whole of the organ patients are bereft of the power of speech. That this is an unfounded fear has been already shown (p. 554). When this is better known generally, and also the fact that when epithelioma is taken early, removal of half the tongue will suffice to secure against its return, we may hope for less hesitation in seeking early relief.

But there is another aspect of the question hardly less important than that of the complete extirpation of the cancerous disease—namely, that even supposing in any given case we cannot hope to secure the patient from recurrence, the disease having been allowed to go too far, we may yet by free excision of the organ give very great relief for the rest of the sufferer's life, even if we should not prolong it. It is now a well-known experience that when recurrence after such operations does take place, it is very rare for it to appear in any part of the stump of the tongue or mouth. The latter remain quite free from the disease to the end in a large majority of cases, while the glands of the neck or the internal organs become the seat of the finally fatal recurrence. Removal, then, of the tongue with the original disease frees the patient for the rest of his life from the unspeakable distress due to the presence in the mouth of a most painful and disgusting ulcer, and the dangers of hæmorrhage and septic infection always impending. This advantage of excision is felt so strongly by most surgeons who have had any large experience of cancer of the tongue that, even if the operation were never to give immunity from recurrence or even to prolong life, they would still advise its performance, knowing the comfort thus secured to the patient for the rest of his days.

All this, then, points in the same direction—namely, that the closest study of all morbid conditions of the tongue is called for, and especially those which appear to eventuate in epithelioma; and further, that all delay in dealing with the latter is fraught with danger, free removal being called for as early as may be, in order that all possibility of recurrence may be excluded, and that those very extensive excisions presently to be described, which are dangerous in many ways, may not be necessary.

Wide-reaching and elaborate operations are no doubt called for at present, and have done very good service hitherto, but the hope of the future lies quite as much

in improved and more generally diffused powers of diagnosis of commencing cancer of the tongue as in the further development of these.

What the difficulties and dangers of operations for the removal of the whole or part of the tongue are, whether for cancer or benign growths, cannot be better illustrated than by a table showing their history and development very briefly. It may be mentioned, however, that this table applies almost exclusively to measures undertaken for the extirpation of cancer of the organ, the latter requiring excision operations very rarely for other diseases. In compiling this I have availed myself largely of Just's [1] and Woelfler's [2] very valuable essays. Minor modifications of the chief methods are not noticed here; and yet the list is a long one, showing by the very number of the operations it contains that no one in particular has hitherto proved altogether satisfactory.

They may be divided into two groups—1. The earliest irregular procedures. 2. The definitely designed operations—as follows:—

Earliest Irregular Operations.

1. Pimpernelle, died	1658.	Was probably the first to excise the tongue with success.
2. Marchetti	1664.	Extirpated a cancer of the tongue by actual cautery; probably the first recorded extirpation for this disease.
3. Valens Hoffmann	1692.	Removed a tongue affected with macroglossia.
4. Ruysch.	1737.	Excised with a knife and cauterised with a hot iron.
5. Memonista		
6. Heister	1743.	Gave the first methodical description of operative treatment of cancer of the tongue.
7. Buxdorf	1754.	Excised a true cancer of the tongue with the knife.
8. Guthrie	1756.	Was probably the first English surgeon to excise a cancer of the tongue, using the knife followed by cauterisation of the cut surface.
9. Louis	1759.	Ligatured a 'fungus' of the organ, and later (1774) spoke at length and clearly in favour of total excision for cancer.

Definitely designed Operations.

Ligature.

10. Inglis	1803.	Introduced ligature of the tongue from the mouth for cancer, the cords being drawn with needles through the tongue and round the tumour.
11. Major	1827.	Split the organ down centre to apply the ligature to the diseased half from the mouth.
12. Cloquet	1827.	Also split the organ, but introduced the ligature by a supra-hyoid incision, and strangled the diseased half.

Wedged-shaped Excision.

13. C. J. Langenbeck	1819.	Introduced wedge-shaped excision of diseased part of tongue, with careful suture of the resulting flaps.

Preliminary Ligature of the Lingual Artery.

14. Mirault	1833.	Introduced preliminary ligature of the lingual artery to give a clear bloodless field for extensive excisions. He was followed by Roux, and later by Roser.

Écrasement.

15. Chassaignac	1854.	Introduced the écraseur, employing Cloquet's supra-hyoid method, and defining it more exactly, *i.e.* using puncture in above spot instead of incision.
16. Middledorpf	1854.	Introduced the galvanic écraseur.
17. Nunneley	1866.	Introduced the supra-hyoid use of the écraseur into this country, adopting Chassaignac's modification.
18. Girouard	1857.	Employed circum-puncture with rods of caustic.

Division of the Cheeks.

19. Jaeger	1831.	Was the first to divide the cheek for free access to tongue.
20. Maisonneuve	1858.	Divided both cheeks from angle of mouth for the same purpose.
21. Collis	1867.	Re-introduced Jaeger's operation, using the écraseur.

[1] Schmidt's *Jahrb.*, 1860, p. 245.
[2] *Archiv f. klin. Chir.* v. Langenbeck, 1880, Bd. xxvi. p. 314.

Division of the Lower Jaw.

22. Roux, died . .	1836.	Was the first to divide the lower jaw and lip in mid-line, in order to gain free access to the floor of the mouth and tongue.
23. Sédillot . .	1844.	Improved this method by dividing the bone by a serrated cut.
24. Syme . . .	1857.	Divided the jaw in mid-line, and excised with the knife.
25. Billroth . .	1862.	Divided the jaw and soft parts at the side in two places, and turned down the flap of skin and bone so formed, replacing and wiring the bone afterwards ('osteoplastic operation').
26. B. v. Langenbeck .	1875.	Divided the jaw and soft parts opposite the first molar tooth on one side, in order to gain access to side of the mouth for removal of the tongue, glands, and part of the palatal arch and tonsil.

Infra-maxillary Operations.

27. Regnoli . .	1838.	Opened the floor of the mouth from below by an incision from middle of hyoid bone to chin, ending in another semilunar incision along the border of the jaw. The tongue, being drawn downwards and forwards through the opening thus formed, was excised.
28. Czerny . .	1870.	Modified this procedure considerably, forming lateral flaps.
29. Billroth . .	1871–6.	Modified it still further, extending both ends of the curved incision much further backwards, and omitting the incision in mid-line.
30. Kocher . .	1880.	Introduced a method of opening the mouth from behind and below the angle of the jaw to reach the base of the tongue, and remove it with all the lymphatic glands there situated.

From the above short review we see that the first aim of the earliest operators was the avoidance of hæmorrhage in dealing with the tongue; hæmorrhage which, from its position, would be both difficult to control and particularly dangerous on account of the proximity of the air-passages; hence the use of the actual cautery (2), the strangulating ligature (8, 9, 10, 11), the preliminary ligation of the lingual artery (14), the écraseur simple or galvanic (15, 16, 18).

When this danger had been more or less met, the more radical extirpation of the disease claimed attention, it having been found that recurrence beyond the root of the organ was frequent. Freer access to the deeper parts of the mouth was therefore sought either by splitting the cheek (19) or cheeks (20), or division of the jaw at one spot or other (21, 22, 23, 24, 25, 26), or by various sub-mental or sub-maxillary incisions.

Then when this requirement had been fulfilled and access to all parts of the root of the organ and mouth had been provided for, and the number of operations increased, the attention of surgeons became urgently drawn towards the necessity of guarding against the risk of septic infection which was found to be very frequent after these free operations. This was observed to take place either in the ordinary way from the wounded surfaces, or by the reception into the lungs of the products of putridity in the mouth during the separation of sloughs. To guard against these dangers, various modes of effectually draining and disinfecting the mouth were designed. And then access of pure air to the lungs was provided for by means of a preliminary tracheotomy opening, not to be closed until the wound was cleanly granulating, the mouth and nose being closed in the meantime. This prophylactic tracheotomy had already been introduced by Trendelenburg to obviate the risks of hæmorrhage into the larynx during the operation, but the idea of utilising the opening for breathing during this healing process, and thus increasing the facilities for antiseptic treatment of these cases, occurred apparently to the author and Professor Kocher of Bern simultaneously, and were put to a practical test by both at the same period according to the latter writer.[1]

Finally the question of removing with the tongue all the lymphatic glands in and about the sub-lingual and sub-maxillary space, whether diseased or not, as a precaution against recurrence, has been raised lately, and an operation (30) designed to that end.

Of these various procedures it may be said generally that strangulation of the

[1] *Deutsch. Zeitschr. f. klin. Chir.* Bd. xiii. 1880, p. 147.

whole or part of the tongue by ligature is now abandoned almost entirely. The immunity from hæmorrhage which it gave was more than counterbalanced by the tediousness of the separation of the part, the distress to the patient meanwhile, and the great danger of sepsis during the sloughing process. The galvanic écraseur, too, although still used by some, is less and less employed in this country, and especially in London, by those who have much experience of operations on the tongue. It is found not to give immunity from hæmorrhage, to leave a more fœtid sloughing surface than any other operation, and thus to increase the danger of sepsis, while it is troublesome and uncertain in use.

Fig. 135.—Chain Ecraseur.

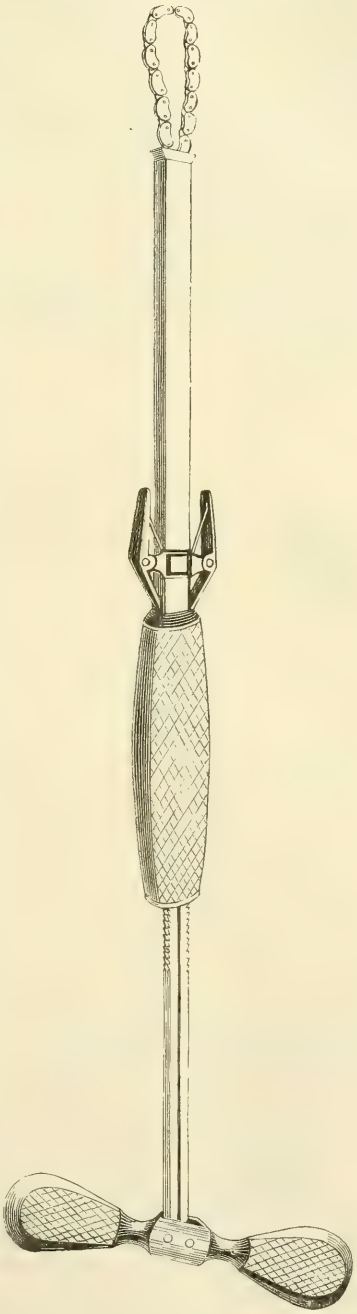


Fig. 136.—Ecraseur for single wire or twisted wire cord

By far the largest number of extirpations of the tongue of any magnitude are now performed either with the knife, scissors, or simple écraseur, either chain (fig. 135), single wire, or twisted wire cord (fig. 136). And the results have improved, though probably not altogether owing to the less frequent use of the galvanic écraseur. At University College Hospital there would appear, however, to be some relation between the abandoning of this last instrument and the improvement. Thus from our tables I learn that of 16 cases operated on by the galvanic écraseur 8 died; while out of 17, where the wire écraseur was used, only 2 were lost.

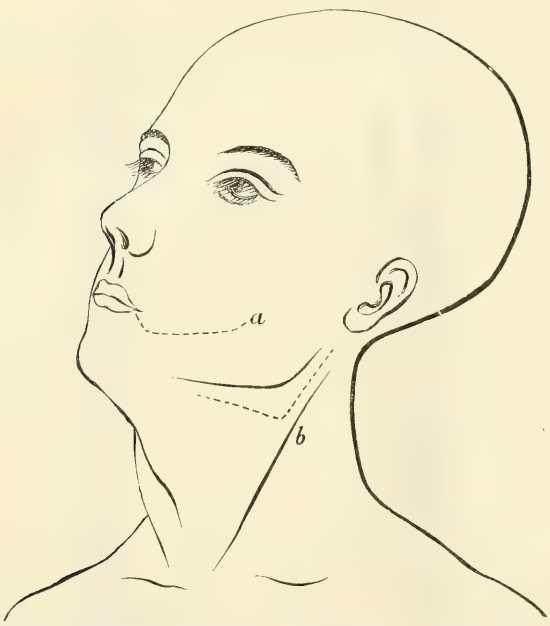
Any of these instruments may be applied to the tongue in numerous ways. But to describe all these would lead us too far, and only the most usual methods will now be mentioned.

They divide themselves naturally into three groups: *firstly*, operations from the mouth, with or without division of the cheek or cheeks; *secondly*, through openings made by section of the lip and jaw; and, *thirdly*, through openings made by incisions beneath the jaw without division of the latter.

1. *Excisions from the mouth.*—For macroglossia, nævus, papillomata, or other benign growths, usually affecting the anterior part of the tongue, removal can usually be accomplished through the mouth. The part to be taken away can be included in a single loop of an écraseur and so divided very slowly; or, two chains or wires having been passed through the middle line from below upwards, the organ may be severed in two planes. Or, again, the knife or scissors may be employed either to sweep it off in one or more cuts, or, what is better, to remove it by two converging incisions (C. F. Langenbeck *l.c.*) meeting in the middle line of the tongue, the resulting lateral flaps being brought together and stitched so as to form a pointed stump. In a case in which I assisted in removing a tongue recently by this method the resulting stump was most shapely, being well pointed and not too thick. This cut may be combined, in the case of very thick tongues, with two horizontal incisions, meeting in the same point (Boyer).

If the disease reach further back, the mucous membrane of the anterior attachments of the tongue, and the genio-hyoglossi muscles may be divided with a scissors at their insertion into the jaw (Paget); the organ thus freed may be drawn upwards and forwards out of the mouth to a considerable distance, and then dealt with, as just described, at a point much further back, the tongue being transfixed with a stout needle if necessary to keep the écraseur from slipping forwards. In this case, if only one half of the organ be but slightly diseased, it may in addition be split down its centre, and the side alone be taken away—an operation performed as early as 1827 by Major and Cloquet[1] using the ligature. This latter method of splitting the tongue into two halves has lately been revived and extensively practised by various surgeons.

Fig. 137.



a, incision through cheek for removal of the tongue by Jaeger's method; *b*, incision for removal at the base of the tongue by Kocher's method.

Again a method of excision has lately been advocated by Mr. W. Whitehead of Manchester[2] which offers several advantages as far as it goes. It consists simply in excising the tongue from the mouth at its root with a curved scissors, snip by snip, commencing at the anterior attachments of the organ, while the latter is drawn forwards and upwards out of the mouth, the insertion of the palatal folds being also snipped through in turn. The chief advantage of this method lies in the fact that there appears to be but little tendency to bleeding from the vessels thus cut slowly with the scissors. It frequently happens that no vessel requires to be tied from beginning to end of the operation. It has of course the disadvantage that it is not directed against the glands which are so frequently the seat of infiltration.

The scissors have also been in use in the same way for some years past elsewhere, and notably in Professor Billroth's Klinik, with very good results. But this operator generally takes the extra precaution of extirpating all the glands at the angle of the jaw by an incision at the side of the neck, sometimes also ligaturing the lingual artery besides.

[1] *Archiv. gén. de Médecine*, tome xiv. 1re série, 1827.
[2] *Trans. Internat. Med. Cong.* 1881, vol. ii. p. 460.

But the belief that even this measure of cutting the anterior attachments of the tongue does not afford sufficient access to its deepest parts, has led many surgeons to enlarge the oral opening by incision of the cheek backwards from the angle of the lips. This was first done by Jaeger [1] in 1837 on one side, and later by Maisonneuve in 1858 on both. Jaeger's operation was revived a few years ago by Collis of Dublin [2] and is still employed by some, Professor Stokes of that city being a warm advocate of this method slightly modified.[3] The incision in this case should be a curved one running from the last molar tooth downwards and forwards to terminate in the angle of the mouth (fig. 137 *a*). It no doubt gives very free access to the tongue, but it is fairly open to question whether, with disease so far advanced as to warrant such a severe measure, some of the operations mentioned below will not be preferable as giving more room on the floor of the mouth for wider excision of the part with the sub-maxillary and sub-lingual lymphatic glands then usually infiltrated. This has been felt by many surgeons, and they have resorted to other measures included in our second group.

2. *Excisions after section of the lip and jaw.*—Thus Roux in 1836 and Sédillot in 1844 divided the lower lip and *symphysis menti* in the middle line, and, separating the two halves of the jaw, removed the tongue freely (fig. 138 *b*). This operation was introduced into this country by Syme [4] in 1857, and modified by him. In his first operation, beside section of the jaw, he divided the attachments of all the muscles running to the symphysis, whereby the larynx lost much of its support, and the patient became unable to keep it out of the way of the discharges trickling backwards from the floor of the mouth. In his second method the genio-hyoglossi and hyoglossi alone were divided anteriorly, the genio-hyoidei remaining. He believed that in this way more power was left to the patient to raise his larynx and keep it out of the way of the putrid matters passing backwards which had been the cause of death, as he believed, of three out of his four cases. The operation, though a comparatively easy one, is very severe, and can only be necessary where the floor of the mouth anteriorly (with or without the bone) is engaged in the disease. The soft parts are divided in the middle line from the border of the lower lip to the hyoid bone, and then the jaw, first drilled through from before backwards on either side of the symphysis, is sawn through vertically either in a straight or slightly serrated line (Sédillot), so that in the latter case they may interlock to a certain extent when brought together again. The insertions of the genio-glossi muscles being now divided with scissors, as well as the mucous membrane along the ramus of the jaw, the whole tongue is drawn well upwards and forwards and removed either by one sweep of a knife at its base or half at a time, which is better, giving but one

FIG. 138.

a, incision for removal of the tongue after section of the jaw in mid-line by Roux, Sédillot, or Syme's methods; *b*, incision for removal of tongue after section of jaw opposite the first molar tooth by von Langenbeck's method.

[1] *De Extirpatione Linguæ.* Erlangen, 1831, p. 9.
[2] *Dub. Quart. Journ.* 1867, vol. xliii. p. 1.
[3] *Trans. Clin. Soc.* 1881, p. 188.
[4] *Lancet,* 1857 and 1858.

lingual artery to deal with for the moment, or by the écraseur preceded or not by splitting the organ down its centre. The greatest immediate danger here is hæmorrhage with consequent suffocation. This, however, can be controlled with comparative ease in the wide gap provided by the division of the bone, and the vessel secured in the usual way with a ligature. If there be any difficulty in seizing it, the fingers should be passed down the pharynx by the side of the epiglottis, and the root of the tongue hooked by it well forwards and outwards against the angle of the jaw, when the vessel will be compressed until its orifice is seen and secured. This manœuvre, which I believe originated with my colleague Mr. Heath, is simple and effectual in such cases and gets over a great difficulty. In two cases in which I operated by Sédillot's or Syme's method myself, I found division of half the base of the tongue at a time remove all the difficulty of securing the lingual artery, which was found on the cut face of the half stump as easily as could be wished, the organ being held forward by the uncut portion. When the latter was then divided, the finger in the pharynx, pulling the root forwards as above, brought the second vessel well within reach. The only real difficulty arises when both vessels are allowed to spout at the same time, each thus obscuring the other. After the tongue has been removed the two ends of the jaw are wired together by means of the holes previously drilled, and then the soft parts are brought together as for hare-lip, the lower angle alone being kept open by a drain tube.

Syme's operation being deemed defective in some particulars, especially in not giving a clear view of the deeper lateral parts of the root of the tongue, another mode of dividing the jaw was devised and practised by Billroth in 1867; but it offers few advantages which simpler operations do not possess, to counterbalance its severity. It consists in dividing the soft parts of the lip and face and the jaw at the side in two places by vertical incisions, and turning down the flap thus made, so as to gain access to the side of the mouth. The lingual artery glands and the tongue itself are thus easily reached; when these have been dealt with, the flap containing the side of the jaw is replaced and secured by wire sutures in the usual way. But the disadvantages of this very severe operation led Billroth to abandon it, and I do not think that it was practised to any extent by other surgeons. In 1875 von Langenbeck, on the other hand, divided the soft parts and jaw from opposite the first molar tooth downwards and forwards to the hyoid bone (fig. 138 *b*), and thus reached the most important aspect of the diseased region. On the removal of the latter, the bone was wired as in Syme's operation, and the soft parts united with sutures, provision being made for drainage. This procedure has not yet found much favour in this country, though I have heard of it being used lately. Nor does it appear to be employed extensively abroad. It would, however, be suitable in certain severe cases in which the disease lay far back and close to the floor of the mouth or jaw itself.

3. *Excisions through openings below the jaw.*—This leads us to the consideration of our third group of operations, including those by which the tongue and floor of the mouth are reached by incisions below the jaw. The first to plan an operation of this kind was Regnoli in 1838.[1] He commenced by making a curved incision under the border of the chin for about 3 inches, and another from the middle of this to the body of the hyoid bone (fig. 139). Through these the floor of the mouth was opened up and all the anterior attachments of the tongue were divided, the latter being then drawn well forwards and downwards through the wound, and removed with the knife. But it was found that Regnoli's method gave really but very limited access to the most important part of the mouth, in cases of cancer—namely, the base and lateral aspect of the tongue where the infiltration spreads. It was suitable, no doubt, for the removal of large non-malignant growths reaching far back, as in Regnoli's case, which was that of a girl of 15 years, whose tongue was the seat of what he described as as a large 'tubercular' mass. Whatever this was, it most probably was not cancerous, in view of the age of the patient and the description of the tumour, and consequently the control of the base of the organ was of less importance, except as far as the vessels were concerned. This first sub-mental operation was then improved

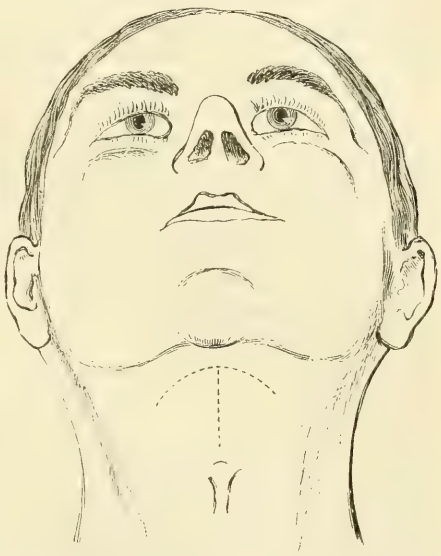
[1] Schmidt's *Jahrbuch*, 1839, Bd. xxiv. No. 2.

upon by another, devised by Czerny with the aim of better reaching the side and root of the tongue. This consisted in opening the mouth from the side, a large triangular flap of the soft parts being formed with its base along the ramus of the jaw, and its apex at the hyoid bone. This flap was turned upwards on the cheek, and then, after preliminary ligature of the lingual artery, the tongue and all the glands in and about the digastric space were extirpated, after which the triangle of skin and soft parts replaced and sutured, due provision being made for drainage of the cavity of the mouth.

Billroth again modified Regnoli's operation by omitting the vertical cut, but prolonging the curved sub-mental incision much further backwards on both sides, so as to be able to ligature one or both lingual arteries before extirpating the tongue and its neighbouring lymphatic glands.

Finally, an infra-maxillary operation has lately been devised and practised by Kocher,[1] which appears to promise considerable advantages beyond the last two, and has hitherto given very good results. This consists in making an incision, commencing a little below the tip of the ear, down the anterior border of the sterno-mastoid muscle as low as the hyoid bone, then forwards to the body of the latter, and so upwards along the anterior belly of the digastric muscle (fig. 137 *b*, p. 600). The resulting flap is turned up upon the cheek, and the lingual artery ligatured before it passes under the hyoglossus muscle. Then, commencing from behind, the glands and all the structures at the postero-inferior aspect of the tongue are removed, together with the latter, the opposite lingual artery, if necessary, being tied first from a separate incision. All this is performed under the antiseptic spray, and the large wound is filled either with Listerian gauze, or a sponge wrung out of carbolic acid solution, and left to granulate up without being stitched, the secretions, in the meantime, escaping into a loose external antiseptic dressing. This operation is only possible after a preliminary tracheotomy proposed by Trendelenburg several years ago for such cases, but first practised by von Langenbeck. This is the first step in the procedure, after which the pharynx is carefully stuffed with a sponge wrung out of carbolic solution and held by a string. All fear of choking from blood being now over, the formation of the flap and excision are undertaken carefully and deliberately, chloroform being administered by the tracheal opening. Moreover, the patient is compelled to breathe solely by the latter, until the excision wound is healing well and cleanly. This last precaution was advocated and put in practice, as Kocher says, independently by him and the writer at the same time. And, from the experience I have had of it in several cases, I can speak very favourably of it, the patient breathing pure air all the time the wound is healing. But of the preliminary tracheotomy in any extensive operation on the tongue, I would venture to speak still more highly. Having been, I believe, the first to adopt the practice in this country, I have watched it with special interest, and am satisfied, after the experience of several cases in which I have adopted it, that the measure will take its place in surgery for certain cases. The comfort of operating when there is no risk of the patient being suffocated by his own blood, and when the state of the suspected tissues can be examined consequently without hurry, and any vessels easily controlled, can only be

FIG. 139.



Incision beneath the chin for removal of the tongue by Regnoli's method.

[1] *Deutsch. Zeitsch. f. Chir.* Bd. xiii., 1880, p. 147.

appreciated by those who have operated by both methods—*i.e.* with and without tracheotomy. The latter operation is comparatively easy when the patient is breathing quietly under chloroform, and does not itself, when thus done, materially add to the patient's danger. It will allow, too, of the wound being treated antiseptically from beginning to end, if we follow Kocher's method.

Choice of operations.—Among all the operations above enumerated the surgeon has a large choice for any particular case. And yet, as a rule, each appears to have a special liking for some one method as his routine practice. And here we find the greatest variety of likes and dislikes, one author advocating this measure and deprecating that as fervently and honestly as another will take the very opposite view. But, if we read the bulk of the most recent literature of the subject, we cannot help feeling that the origin of this diversity of choice lies probably in the different conceptions of the aims of the operation which exist in the minds of surgeons. Many appear to deal with epithelioma of the tongue as though to remove the purely local condition with immediate safety to the patient were their only object. Either this, or they are hopeless of doing more. Others, viewing the matter in the light of the experience that all ordinary operations upon the tongue alone for this disease are followed by almost inevitable recurrence in the neck (if the affection be anything more than just commencing), go a step further, and, while admitting that even to remove the local disease alone is most desirable, contend that, while there is any hope of freeing the patient from all danger of future recurrence, our operations should aim at this, even though they be much more extensive, and involve considerable immediate risk to life. Now, if the first object alone be had in view, many of the operations upon the tongue itself from the mouth will be quite adequate; the local cancerous disease will be removed with but little risk on the whole, and will not recur, *in the mouth at all events*, except in rare instances. But it will recur in the lymphatic glands in an enormous proportion of cases. This last is no loose statement, but appears from an examination of a very large mass of recorded facts as well as from the observation of a considerable number of cases operated on by my colleagues and myself at University College Hospital. This being so (as we shall see presently from an examination of the statistics of the operation), surely we are justified in undertaking very extensive operations on the tongue and its surroundings, and in running considerable risk in the hope not only of removing what is palpably diseased, but also those tissues around, of which we know that in ninety-nine cases out of a hundred, if they are left, they will develop the disease later on. That the whole tongue should be removed except in cases where there is but a small nodule clearly localised in one border of the organ, is quite decided. The risk of leaving a little disease behind in the remaining half is too great to justify such conservatism. And the results to the patient as regards eating and speaking are as good, if not better, after total extirpation, as after removal of one half. It has been noticed that the scar down the centre of the mouth, where half is left behind, often interferes materially with the movements of the latter. Still with disease of small extent, limited to the border of the organ as far as the fear of recurrence is concerned, we need not go far beyond the middle line; for the track of the lymphatics is for the most part away from the latter towards the root.

Frequency of recurrence.—That recurrence *has hitherto been the rule*, after the ordinary operations for cancer of the tongue, I venture to think I am justified in stating from the following considerations:—I have before me five series of cases, in which full particulars of the operations and their results are given as accurately as could be. These make up an aggregate of 170 individuals upon whom extirpation of the whole or part of the tongue for cancer was performed. To these I might add a very large number of cases collected from journals, &c.; but for the object in view we shall approach nearer to accuracy by taking only completed series where aggregates of individual operators or institutions are given without omissions. The above total of 170 includes 87 patients under Billroth during 1867–1880 inclusive; 38 at University College Hospital during 11 years (1871–1881 inclusive); 14 by Prof. Kocher; 9 by Prof. Rose of Zürich (1861–1875); and 22 at Middlesex Hospital. In this large number I only find 17 cases of non-recurrence after an interval of a year

as follows: 9 from Billroth's Klinik after $1\frac{8}{12}$, $5\frac{7}{12}$, $1\frac{8}{12}$, 3, 3, $3\frac{6}{12}$, $2\frac{6}{12}$, $2\frac{6}{12}$, 1 years respectively; 2 from the Middlesex Hospital table after $2\frac{7}{12}$ and $1\frac{4}{12}$ years each; 1 by Heath after 10 years; 4 by Kocher after 14 months, 5 years, 5 years, and $6\frac{1}{2}$ years respectively; and 1 by Prof. Rose after 2 years. Others, of course, may have recovered and been lost sight of, but it is always usual for the successful cases to come to the surface. Be this as it may, the above figures are significant.

But, even if we search the whole literature of the subject, and accept allusions to cases not fully recorded, but stated on good authority to be cured, we find but very few cases of immunity for any number of years from recurrence after this operation. In addition to the above, I have only been able to collect 25 out of some hundreds of operations. Thus Weber [1] quotes a case by Travers with no recurrence after a year; 1 Chelius, in which the patient lived 12 years; and 2 by himself, well at $1\frac{1}{2}$ and 2 years respectively. Again Kocher [2] quotes, besides his own four cases, 1 by Simon, free after 12 years; 2 by Lücke, after a year; 1 by Baum, 'out of all his operations;' 1 by Esmarch, after four years; Winniwarter another, operated on by Schuh, after 13 years; then Schläpfer [3] mentions a case operated on by Rust, in which there was stated to be no recurrence. Further, Professor Verneuil [4] states that, out of about 200 excisions he had done, he could only regard 4 as cured. Then Whitehead [5] alludes to 1 case of his own, where there was no recurrence after 9 years; 1 by Buchanan, after 15 years; 1 by Nunneley, after 4 years; 4 by Hutchinson, after from 3 to 4 years; and 1 by Lund, after over 2 years. Finally, Stokes mentions two cases, operated on by himself, where no recurrence had taken place after 22 and 18 months respectively.[6]

And even though we should accept as beyond every doubt that these were all cases of true epithelioma, we have in this aggregate of 42 a very small percentage of permanent recoveries on the total of operations (which amount to several hundreds) performed by the whole group of surgeons whose names have just been given. Nevertheless some of these, about which there could be no question, must encourage us, showing, as they do, that cancer of the tongue can be completely extirpated beyond all danger of recurrence. What the exact proportion of permanent recoveries to the operations undertaken really is, it is impossible to say; the above figures are only given as suggestive as far as they go. When more accurate records are kept at our larger hospitals generally, we may hope for much light upon this subject.

As to which of the various methods of operation can claim the largest number of the above 42 cases of non-recurrence, I find it difficult to speak positively for want of accurate details. But this much is significant, that the surgeon (Kocher) who can show the largest percentage of permanent recoveries on the total of his operations (4 out of 14) is one who is not content with removing the diseased tongue alone, but also takes away all the tissues lying between it and the sub-maxillary lymphatic glands, as well as the latter themselves as far even as close to the carotid artery. Moreover operating by this, his own method (see p. 603), he has only lost one patient, and this apparently by an accident. Again, in Heath's case the operation was an extensive one, with removal of part of the *symphysis menti*. But, although it is not safe at present to institute a comparison based upon scanty statistics as to the relative immunity from recurrence to be expected from the different methods of operation, I incline to the belief, from study of recorded cases, that in the future we shall have vastly better results in this respect from those in which the lymphatic glands belonging to the tongue are systematically and regularly removed with the latter, whether they be palpably diseased or not, than from any others.

Of course this whole question turns upon our estimate as to when a patient can be considered as really beyond the danger of recurrence. This is a difficult point to determine positively; but, so far as our general knowledge goes, it seems tolerably safe to infer that, if there be no trace of the disease a year after operation, the patient may be pronounced free of the disease. Cases, however, are on record where, after as many as

[1] *Pitha-Billroth's Handbuch d. Chir.* Einband vi. p. 332.
[2] *Deutsch. Zeit. f. Chir.* 1880, Bd. xiii. p. 147.
[3] *Extirpation der Zunge*, Zürich, 1878, p. 72.
[4] *Bulletin de la Soc. de Chir.*, 1880, p. 621.
[5] *Trans. Int. Med. Cong.*, 1881, vol. ii. p. 466.
[6] *Trans. Clin. Soc.*, 1881, p. 188.

two and a half or even thirteen years after removal of the tongue, disease has started again in one or other part of the mouth. (Schuh's case mentioned by von Winniwarter.) Whether this last and other similar cases are to be regarded as recurrences or not, the future must decide. It appears probable that they are rather a fresh and independent development of the disease in a patient with a strong predisposition to cancer.

Does operation prolong life where recurrence takes place?—Another point now claims our attention before going further: namely, whether, in cases where permanent cure does *not* result, the operation of extirpation of the tongue can be regarded as prolonging life. To estimate this, we must first know what is the average life of a patient affected with cancer of the tongue not operated on, from the first appearance of the disease until it destroys him. Observations in this direction, conducted by independent observers, have hitherto led to tolerably uniform results. Of the 22 cases from my own list not operated on, only 3 died in hospital, and the duration of life had not been traced in the rest. In these three, however, death occurred on an average of 13·0 months after the appearance of the disease, and are tabulated below as far as they go.

	Not Operated on		Operated on	
	Number of cases traced	Average on these in months	Number of cases traced	Average on these in months
Paget	—	22·7	—	35·0
Anger	—	14·0	—	24·0
Clarke	25	10·5	14	21·5
V. Winniwarter	4	13·0	11	19·5
Author	3	13·0	4	18·5
Morris	17	10·5	15	16·5
Woelfler	—	—	10	19·2
	49	11·7	54	19·0

In the above list we find 49 cases from which to judge of the length of life without operation, reckoning from the first appearance of disease until death; and on these the average is found to be 11·7 months. On the other hand, the average duration of life in 54 cases operated on, stands at 19 months, showing a clear gain from operation of 7·3 months. If to these figures we add the computations of Paget and Anger, as above, where the number of cases is not given, we find the averages altered to 13·9 and 22·0 months respectively, or a gain of 8· months. The first sets of figures, however, from all I can learn, are probably much nearer the truth than the latter, which appear to place the duration of life too high in both instances. I have thought it well to give them, nevertheless.

From these figures, which represent the deductions of several independent observers, it would appear that life is prolonged by about seven to eight months by operation for cancer of the tongue. This would, in the minds of many, justify very severe operations, even supposing there were not the possibility of the disease being completely eradicated thereby, as we have seen it has been in certain cases.

Now, as a set-off to these advantages of extirpation of the tongue, there are the grave dangers attending the operation to which we must not shut our eyes.

Mortality after excision of the tongue.—In order to gain a general idea of these, we may in the first place glance at some of the larger recorded series of cases where the whole results of an operator, an institution, or a particular operation are given without selection of cases. In examining the gross mortality in these, we shall be able to form a fair estimate of the general dangers of removal of the whole or part of the tongue for cancer. And here it may be remarked that it is almost impossible to classify operations on the tongue, according to the amount excised, with sufficient exactness to justify a strict statistical comparison of the dangers incidental to the removal of one quantity or another. I shall therefore include in the groups of cases to be examined all operations undertaken for the removal of cancer of the tongue, which have been anything more

than the snipping of a fragment of the organ from the mouth. Afterwards an endeavour will be made to point out some of the relative dangers of the various procedures.

Taking the operations of Billroth's Klinik for cancer of the tongue first, we find a gross mortality on 100 individuals of 26 per cent., or on 119 operations upon these, 22·6 per cent. This list embraces all his operations during the years 1860–1880 inclusive. In these numbers those operations performed before October 1867 are also taken into account by Woelfler, from whom I quote these particular figures. I have not mentioned these before in other computations, not having the details before 1867 at hand. From our own table, including all extirpations performed at University College Hospital, and amounting to 38 during the eleven years 1871–1881, I find that 10 died, or 26·3 per cent.; but of the last 18 cases operated on since January 1877, only 2 have been fatal, or 11·1 per cent. Kocher and Rose's series combined, amounting to 23 cases, show only 2 deaths, or 8·6 per cent.; and the Middlesex Hospital list on 29 cases, only 3 per cent. In Whitehead's series of 28 cases of his own operation in the hands of different surgeons, he states the mortality at 21 per cent. at the highest computation. Here, then, we have a total of 218 individuals who underwent extirpation of the tongue for cancer, representing the work of several German and several English surgeons for some twenty years; and of these the average mortality was 16·9 per cent. The differences in mortality between these several lists may be explained in great part by the differing gravity of the operations included in each. It would be possible to collect a much larger number of cases from journals, &c.; but such a collection would not form a trustworthy basis for estimating the danger of removal of the tongue, and I have preferred to take some of the most carefully recorded series I know of, all operated on within the last twenty years. Now, a loss of 16·9 per cent. of patients after any operation must always be considered a very grave mortality, and every effort must be made to reduce it. And it is reassuring to learn from an examination of the tables, including the results of a series of years, that those operations which fall within the last five do show a much lower proportion of deaths than those of the preceding fifteen. Those anterior to the beginning of our last decennium were still more fatal. Thus, Syme lost 3 out of his 4 cases.[1] Again, during the first six years of our own table, the mortality was as much as 40·4 per cent. on 20 cases, while in the last five it has fallen to 11·1 per cent. on 18 individuals. A similar improvement is apparent if we examine Billroth's series. Here we find 56 patients operated on between 1860–1876 inclusive; of these 17 died as a consequence, equalling 30·3 per cent., or 25 per cent. on the number of operations performed. Or, again, in the same practice from 1871 to 1876 inclusive, 42 individuals were operated on, of which 17 died as the result, amounting to a mortality of 40·4, or 36·1 on the operations performed on these 42 patients. Now, in contrast with these figures, we have the statistics of the same Klinik for the years 1877–1880 inclusive, and these show a very material improvement. There were, namely, 44 patients operated on in the corrected table. Of these, 9 died as a consequence, equalling only 20·4 per cent., or 17·6 per cent. if we reckon the number of operations performed on them. Moreover, since then the results in Billroth's Klinik have still further improved, so far as the number of cases go, as we learn from a recent article on the subject, for which we are again indebted to Woelfler.[2] In the series of cases here recorded, amounting to 17, there has not been one death: a result attributable manifestly, as will appear from a perusal of the clinical notes, to the greater success in the after treatment of the operation wounds. In this direction a most important advance has already been made in the Vienna Klinik; and this, owing to a careful study and appreciation of the dangers of this particular class of operations. In this country, too, a very great improvement here has also taken place. At University College Hospital, for instance, there have been lately far less of those after complications, which used to be so dreaded, than formerly.

Now, if it be asked to what is this decrease of mortality of late years due, it may be replied generally that it is rather to a better understanding of what the dangers

[1] *Lancet*, 1857, 1858, 1865, 1866; and *Med. Times and Gaz.*, 1865.
[2] *Archiv f. klin. Chir.*, Bd. xxvii. 1882, p. 419.

incidental to tongue extirpation really are, and the way to avoid them, than to any decrease of severity in the operations performed; for, if anything, the latter have on the whole become more extensive. These risks have already been alluded to generally (p. 598), and must now be regarded a little more closely.

Special dangers of excision.—It was stated above (p. 598) that the greatest dangers in operations on the tongue were: *first*, bleeding; *secondly*, sepsis of the ordinary pyæmic form; *thirdly*, lung affections produced by the mechanical entrance of foul matters into the air-passages from the unclean wounds in the mouth. The first of these has always been recognised; the last two have gradually become better known, and whether confounded clinically one with the other, as is often the case, or regarded as distinct affections, have at last come to be considered as the most important of all.

Bleeding.—Now, when bleeding is spoken of here as a danger, it is not in the usual sense, *i.e.* that the actual loss of blood, primary or secondary, is to be feared: it has rarely or ever proved fatal in this way. It is rather that the blood poured out into the cavity of the mouth finds its way very easily into the air-passages during inspiration, and leads to suffocation or (contaminated with the septic discharges from the mouth) to putrid inflammation in the lungs. Before the use of chloroform this was not so much to be feared. The patient, as in Syme's first operations, was placed in a sitting posture by which most of the blood flowed forwards, while any that flowed backwards was coughed up. But now, with the patient on his back, a very little fluid in the mouth is quite sufficient to cause danger from trickling into the larynx, from which it is not expelled owing to the feeble expiratory efforts resulting from the narcotic. It is rather sucked further and further into the smaller bronchi. But it may also be suddenly poured out from a cut lingual artery in such amount as to threaten immediate suffocation and require laryngotomy on the moment, as occurred in four cases at University College Hospital, one of them under my own care. The difficulty of at once catching the vessel lies here in the fact that either the latter is quite obscured by the collection of blood which it suddenly pours over itself, or, the two arteries being cut together, one rapidly covers the other with its blood.

This danger has been variously met from time to time: at first by the use of the strangulating ligature or actual cautery for the removal of the tongue; then, later, by the use of the écraseur, either galvanic or simple; then by trusting to ligature on the face of the wound after removal by the knife where a preliminary tracheotomy had removed the risk of suffocation; and, finally, by the revival of an older operation—namely, preliminary ligature of one or both lingual arteries.

Of the different merits of these various procedures it would be impossible to speak at length in an essay such as the present. It need only be said that the galvanic écraseur does not give immunity from hæmorrhage, either primary or secondary. In two of the cases referred to above, where laryngotomy had to be performed on the table for bleeding, this écraseur was being used by most experienced surgeons. And in other recorded cases we find the same trouble arising.

Nor does it secure against secondary hæmorrhage, as is seen by a perusal of recorded cases. And yet this instrument is spoken of very favourably by other surgeons. But it has disadvantages, apart from the question of bleeding, which condemn it in the minds of the majority, especially the extent and great fœtor of the resulting slough, so that of late years it has come to be very little used.

The ordinary écraseurs, however, are still much used, especially in this country. Various forms are employed—namely, the chain (fig. 135), the single wire, or the wire cord (fig. 136). Of these the last is best, especially if that fine twisted cord be used, introduced to the notice of the profession by Mr. Barwell. The chain is, on the whole, clumsy and apt to 'kink,' even though it be flexible in a double sense, as in the most recently improved French instruments, where the articulations are doubly jointed. The single wire, on the other hand, tends to cut too rapidly through the soft tissues, while it may not divide or crush the vessels at all in the last loop it forms as it passes through the eye of the stem. Thus the lingual vessels and nerves are often drawn out uncut in a long wisp when the wire was quite 'home' within the stem of the instrument; and this where there was no undue hurry. The wire cord,

on the other hand, cuts less evenly and rapidly, and can be made to form a smaller loop as it passes through the eye of the stem, so that its effect on the vessels is more thorough.

Ligature of the lingual artery on the face of the tongue stump is perhaps not so difficult if but one half of the organ be divided at a time, the whole being drawn well forward by a finger hooked round its base in the pharynx, as recommended by Mr. Heath. Of the value of this last measure I have convinced myself practically in more than one operation. Cutting one half at a time with a scissors, snip by snip, appears to give time for the arrest of bleeding very effectually, as we learn from Whitehead's series of cases operated on in this way. Latterly, preliminary ligature of the lingual artery has been very freely practised abroad and with the best results by (Woelfler [1] Kocher [2]); and in a case in which the writer has recently adopted the practice, he has found it most satisfactory. It has the advantage of making sure of the lingual vessels; and, as it can be combined with extirpation of the lymphatic glands at the root of the tongue, it will probably come more into favour still, especially as advances in antiseptic surgery in this region have removed to a great measure the dread of extensive burrowing of matter in this part of the neck. Finally, one of the aims of preliminary tracheotomy, introduced by Trendelenburg, has been to reduce the danger of inspiration of blood into the lungs during operation, and so remove the source of anxiety to the surgeon while performing an operation which calls for deliberate work in all cases, and especially if we are aiming at the removal of lymphatic glands at the root of the tongue. And I venture to think that any surgeons who have adopted this line of practice for serious cases, will agree that the comfort of dealing with the diseased region without any risk to the patient from sudden suffocation with his own blood, makes up for any slight addition to the whole operation. I have only employed this measure four times among my own cases, but, as far as this experience goes, it leads me to think very highly of it. In my last two cases I regretted not having done a preliminary tracheotomy; for in the first of these I was obliged, just as the wire cord écraseur began to cut, to perform laryngotomy in a hurry on account of asphyxia from bleeding, and, although the patient recovered well, I regretted that I had not begun by opening the windpipe. When the latter is open, and a carbolised sponge is firmly jammed in the pharynx (which is to be preferred to the india-rubber bag tampon of Trendelenburg), the patient breathes easily through the cannula, and neither blood nor mucus can enter the larynx. It is in such a case immaterial what instrument is used to remove the diseased structures as far as any bleeding is concerned, and the surgeon can examine the suspected area at his leisure as he proceeds with his extirpation. When the knife is used for the latter, it has the advantage that the tissues around are not bruised or otherwise altered, as with either of the écraseurs, and thus the search for any secondary deposits can be conducted with more certainty.

It is objected to this procedure that the risks of tracheotomy, immediate and remote, are added to those of excision of the tongue. But the immediate dangers of opening the windpipe, when a patient is breathing quietly under chloroform, are not to be compared to those incidental to the operation when there is struggling and gasping for breath, as in the condition for which we are most commonly called upon to interpose in this way, and it is a mistake to compare the two operations. And if I may venture to cite the experience of four cases of preliminary tracheotomy, I may say that they were as easy operations as one could wish, and a great contrast to others I have done in a hurry for imminent asphyxia. As to the remote dangers of tracheotomy, they may be regarded as of less moment in the adult with strict cleanliness and otherwise careful nursing, and they are more than counterbalanced by the advantages to the surgeon in dealing with the tongue and the elimination of other immediate and remote risks to the patient, especially by freer and more deliberate removal of the infiltrated parts.

Septic lung affections.—We come now to the consideration of the other two

[1] *Archiv f. klin. Chir.* Bd. xxvii. 1882, p. 419.
[2] *Deutsche Zeitsch. f. Chir.* Bd. xiii. 1880, p. 146.

dangers connected with extirpation of the tongue—namely, pyæmic lung affections and those produced by direct infection of the lung tissue through the air passages. These have often been spoken of together; and, before showing that they are clinically distinct conditions, as I think will appear, it may be well to examine what proportion of patients fall victims to them (taken together) in a total of fatal cases. In order to estimate this approximately, I have for a long time past been collecting all the deaths from primary extirpation of the tongue which I could find accurately recorded. The list of those before me now includes 52 fatal cases taken without choice from the experience of a large number of operators, home and foreign, operating by the most various methods. A few others I have come upon might be added to these; but, as they are only mentioned without any accurate data being given further than that they died of 'pneumonia,' I have thought it unnecessary to include them, and have preferred rather to deal with a round number of 52 more accurately recorded. Of some of these it will be seen that points are lacking which it would be interesting to know, but without these the table is sufficiently instructive and very suggestive.

The first thing to be noticed in the following table is the very large number of deaths after excision of the tongue attributed to pulmonary affections. Of those who died, the lungs were deeply involved in 30. Now, of these the fatal affection is described as 'pneumonia,' 'bronchitis,' or 'broncho-pneumonia,' or 'gangrene of the lung' in 21, the rest being set down as 'pyæmia with abscess in the lung.' Then there are 4 deaths referred to 'pyæmia;' 2 of these (10 and 37) are without note as to the state of the lungs on the day after operation on which the patient died; another (36) shows the lungs to be healthy (a case of my own); in the fourth (48) they were plainly only secondarily involved. Next we have 6 put down to 'septicæmia,' 'septo-pyæmia,' or 'sepsis,' without lung affections being mentioned. The remaining 10 deaths arrange themselves as follows: collapse 3, exhaustion 2, shock 1, asphyxia from falling back of root of tongue 1, fatty heart (probably shock) 1, wound diphtheria, &c. (? septicæmia) 1, œdema glottidis 1, erysipelas 1.

The next point that strikes us is the very early appearance of those symptoms which preceded the fatal result in those 21 out of the 30 in which disease of the lungs is described as the chief factor. On an average of 13 cases where this point is mentioned these symptoms set in on 4·7 day. Also the shortness of life when these had once appeared is remarkable, only equalling 7·7 days calculated from the same 13 cases, or 7·6 if 20 in which this point is noted be used.

Again, it is worthy of note that those cases set down as dying of 'pyæmia,' with or without abscess of the lung, developed bad symptoms at a much later date, and lived far longer than the last group. Thus the dangerous symptoms set in 11·3 days after operation on an average of 6 cases where notes on this point are given, and the patients lived (in 7 cases) on an average 25·4 days. And if we take one of the cases where the lungs were found healthy, while there were distinct pyæmic abscesses elsewhere, we find that the bad symptoms set in on the 14th, and the man lived until the 55th, day. Again in another of these 7 cases, where the lungs were manifestly only secondarily involved, the symptoms set on the 18th, the patient lived until the 24th, day.

Now, although I should be sorry to base an argument positively on the above figures alone, extracted from a table compiled from such various sources, and probably differing considerably as to nomenclature, still they suggest conclusions similar to those which may be drawn from clinical observation. In a considerable number of cases terminating fatally not only after operations on the tongue alone, but those directed against other parts connected with the air passages (mouth, jaw, larynx), which I have had an opportunity of studying during life and in the post-mortem room, I believe I have observed two distinct kinds of fatal disease which would correspond to the groups suggested above. One, a rapidly fatal form of lung inflammation peculiar to operations on any of the air passages, and due to the direct irritation of the pulmonary tract by septic products; the other, a less rapid but equally fatal form of disease possessing the characters of ordinary surgical pyæmia or septicæmia, and with or without any damage to the lung. If the latter exist here, it is only a late

List of recorded Fatal Cases of Extirpation of the Tongue, showing

No.	Operators	Reported cause of death	Date	Mode of operation	Symptoms set in on	Death on
					day	day
1	Cloquet. .	Bronchitis; suppuration of cervical glands	1827	Tongue split one half; ligatured by suprahyoid method	1st	3rd
2	Bruns . .	Septicæmia	1850	Strangulation with cord from mouth	4th	6th
3	Syme . .	Pneumonia	1857	Excis. with knife; S.'s older method	5th	7th
4	Syme . .	Pneumonia	1858	„ modified method	3rd or 4th	5th
5	Syme . .	Pneumonia or pyæmia	1858	„ „	—	10th
6	King . .	Pyæmia; pneumonia	1862	Syme's older method	—	9th
7	Buchanan .	Pyæmia; abscess in lung	1865	„ modified method	6th	9th
8	Collis . .	Pyæmia, gangrene of wound	1865	Syme's method	—	—
9	Gamgee. .	Gangrene of wound and exhaustion	1868	Écraseur; Regnoli's method	5th	12th
10	Hill . .	Pyæmia; abscess in lung	1869	Lip and jaw divided; chain écraseur	16th	20th
11	Erichsen .	Pneumonia	1869	Écraseur; Regnoli's method	7th	8th
12	Heath . .	Pneumonia or pyæmia	1870	Galv. écraseur from mouth	4th	7th
13	Menzel . .	Œdema of lungs; bronchitis; enteritis (? septicæmia)	1873	Prelim. lig. of ling. art.; sub-mental excision with knife	24th	32nd
		From Billroth's Klinik, Oct. 1867, *to Jan.* 1879 (*von Winniwarter's table*); *excluding four after secondary operations on glands, one from suicide, one perforation of stomach from feeding-tube.*				
14	—	Septicæmia	1868	Divis. of jaw; excis. of T. and floor	—	3rd
15	—	Pyæmia, abscess in lung	1872	Sub-maxillary operation	—	34th
16	—	„ „	1872	Sub-maxillary operation, with removal of T. and floor of m.	8th	21st
17	—	Collapse; no p.m.	1872	Galv. écras. from mouth	5th	5th
18	—	Broncho-pneumonia	1873	Sub-maxillary operation	—	9th
19	—	„ „	1874	Lig. of ling.; excis. from mouth	—	4th
20	—	Bronchitis	1874	Sub-maxillary	—	7th
21	—	Diphtheritic condition of wound; delirium; no p.m. (? pyæmia)	1874	Lig. both linguals; excis. from mouth, and partly sub-maxillary	4th	11th
22	—	Collapse; no p.m.	1874	Prelim. lig. of both linguals; excis. of T. and floor of mouth	—	11th
23	—	Bronchitis; pleuritis	1875	Sub-maxillary	—	4th
24	—	Pyæmia; abscess in lung	1875	Osteoplastic	6th	15th
25	—	Broncho-pneumonia	1875	From the mouth	2nd	4th

University College Hospital List, 1871 *to* 1881.

No.	Operators	Reported cause of death	Date	Mode of operation	Symptoms set in on	Death on
					day	day
26	—	Septicæmia	1871	Strangulating lig. from mouth	4th	9th
27	—	Pneumonia; gangrene of lung	1873	Galv. écraseur from mouth	5th	7th
28	—	Septicæmia	1875	,, ,,	4th	12th
29	—	Œdema glottidis	1875	,, ,,	4th	11th
30	—	Bronchitis; pleurisy; pneumonia; gangrene	1875	Galv. écraseur, after removal of symphysis	7th	13th
31	—	Pneumonia, with abscesses	1875	Galv. écraseur, after division of symphysis	5th	8th
32	—	Pneumonia; gangrene of l.	1876	Galv. écraseur by mouth	2nd	3rd
33	—	Broncho-pneumonia	1876	,, after division of symphysis	7th	9th
34	—	Broncho-pneumonia	1877	Galv. écraseur from mouth	2nd	3rd
35	—	Double pneumonia	1878	Wire écraseur from mouth	4th	5th
36	—	Pyæmia	1879	Wire écraseur, suprahyoid	14th	55th
		From Billroth's Klinik, 1877–1880 *inclusive.* (*Woelfler's table.*)				
37	—	Pyæmia	1877	By scissors from mouth	—	—
38	—	'Septo-pyæmia'	1877	Excision through mouth	2nd	3rd
39	—	'Sepsis'	1879	By scissors through the mouth	3rd	8th
40	—	Pneumonia; gangrene of l.	1879	,, ,,	12th	26th
41	—	Fatty heart and liver; lungs healthy	1880	Sub-maxillary method	—	2nd
42	—	Laryngitis; pneumonia	1878	Lig. ling.; excis. of whole tongue	—	4th
43	—	Erysipelas	1879	Free excis. from base of tongue, front border of sterno-mastoid	—	—
44	—	Collapse; drunkard	1878	Lig. both ling.; excis. of T. and floor	—	2nd
45	—	Double pneumonia	1880	,, ,,	—	11th
46	—	'Septo-pyæmia'	1877	Partial resection of jaw and T.	—	8th
47	Rose . .	Asphyxia from falling back of root of tongue	1872	Resect half of jaw with half the tongue by écraseur	—	5th
48	Whitehead .	'Septic pneumonia'	1881	By scissors from mouth	—	12th
49	Lediard .	Shock	1881	,, ,,	—	14 hours
50	Kocher . .	Pneumonia	—	Sub-maxillary method at base of T.	—	—
		From Bartholomew's Hosp. Reports, 1877, *p.* 573.				
51	—	Pyæmia, with abscess in kidney, spleen and lungs	1877	—	18th	24th
52	—	Exhaustion; hæmorrhage	1877	—	—	—

complication, and quite secondary to the general condition, and not the immediate cause of death usually; whereas in the first group the affection of the lung is the primary disease and the immediate cause of the fatal issue.

Again, it has always appeared to me, judging from the cases I have seen—and I think I am borne out by the published notes of others—that within the first group there are clinically two *varieties*, both produced by direct inoculation, but differing somewhat as to the mode of production, as well as in the condition found in the lung. One appears to arise from the direct infiltration of portions of the lung, with foul matters in a fluid form making their way down one or other bronchus—'Verschluck-pneumonie' of the Germans. The other seems to be due to the constant inhalation of the intensely fœtid and irritating gases produced by putrefaction where there is death of tissue in the mouth after operation; but where we have no evidence of the fluid products of the latter having found their way into the bronchi. In the first variety we usually find *post mortem* a number of small, foul, fairly limited abscesses; in the second, a widespread diffused inflammation running into absolute gangrene over large areas.

Now if this be a correct view to take of the nature of what may, perhaps, for the present be called 'surgical pneumonia,' as distinct from secondary (probably embolic) abscesses in the lungs as the result of ordinary pyæmia, we must have three great aims in view in the after treatment of our excisions of the tongue, if we wish to eliminate the greatest dangers of this operation. In the first place we must operate with the strictest antiseptic precautions possible, so as to avoid the risks of ordinary pyæmia; then we must do so in such a way that the fluids produced in the wound of the tongue and mouth shall either be kept from decomposition or drained away from that cavity, so as not in any way to reach the air passage; thirdly, we must go beyond this, and either render the air inspired through the mouth pure, or provide an entrance to the bronchi which shall eliminate the necessity of breathing by the mouth at all.

And I think that this view will be found to be correct by those who follow a number of these cases clinically, and afterwards examine the lungs.

Cases belonging to the *first variety* will generally exhibit the following features. A patient whose tongue has been excised progresses very favourably for the first day or two, his temperature, pulse, and respirations being little if at all above normal. He then becomes troubled with the accumulation of frothy mucus and saliva from the mouth, nose, and pharynx, which he finds a difficulty in swallowing and a far greater difficulty in spitting out. What comes from the mouth is very abundant, and is mixed with the secretions from the wound. The tendency to decomposition in this is very great in all but the smallest operations (where it can be constantly spat out or swallowed with ease), and, as a rule, unless strong antiseptics be used with the greatest perseverance, it becomes abominably fœtid, especially about the end of the third day or so, when separation of sloughs begins. The patient now finds great trouble in clearing his mouth and pharynx of the viscid secretions accumulating, and generally complains of their tending to suffocate him. Do what he will, he cannot clear his throat and larynx of what lies around. On about the 4th or 5th day, then, he complains of troublesome cough, and temperature and pulse run up with the respirations. These symptoms become rapidly worse, the signs of pneumonia appear as in an ordinary case; then the patient suffers the most acute dyspnœa, becomes cyanosed, and usually dies about the 8th or 9th day.

When the lungs are examined in such a case the first point noticed is the horrible fœtor which they exhale. We find the trachea and bronchi, as a rule, deeply congested, and in the parenchyma of the organ numerous small abscesses, distinct from one another with ragged gangrenous walls, and an area of discoloured œdematous pulmonary tissue around. In addition to this there may be patches of pleuritis over the damaged areas.

As an instance of the *second variety*, let us take a case of this kind which may be considered as typical. It is that of a man, aged 58, strong and healthy, operated on in 1876 for epithelioma of the tongue by Syme's method. For the first few days he felt so very well that he asked leave to get up and remain by the fire. His

mouth, however, became intensely fœtid, in spite of all the means I could then contrive to prevent it. He was not particularly troubled with saliva and mucus, as there was a drain-tube in the floor of the mouth, but the fœtor was horrible. On the 7th day he complained of cough, which rapidly became troublesome; soon after his breathing became very short; he then became cyanosed, and died on the 9th day. I was away when the body was examined, but the cause of death is described by Mr. Gould, who made the necropsy, as 'broncho-pneumonia.' But from several other cases (under different operators), similar clinically, in which I have examined the lungs after death, I have found intense congestion of the bronchi, and then extensive gangrene of the lung over large areas, without any actual abscess perhaps. The pulmonary tissue has presented the appearance rather of having been killed *en masse* over large areas, and without a great amount of previous consolidation, or present softening and breaking down. These appearances are the same as those observed by others in similar cases. The part affected is of a greenish-brown colour, and looks more flabby and œdematous than solid. Here there will probably be less lymph exuded on the surface of the organ, but there may be a considerable amount of serosity in the pleura. The fœtor of this, as well as that of the lung itself, is something beyond description.

These two varieties of disease then differ from that form of lung affection produced in the course of ordinary pyæmia, where abscesses form in the lung substance, in being apparently the result of direct irritation of the respiratory tract from without, and not the sequence of any general blood condition as in the latter disease. They differ also clinically in coming on much earlier, in not being usually accompanied by rigors (only noted in one of the cases at our hospital), and in having a steady high temperature. They are equally fatal, death occurring at even an earlier date in surgical pneumonia than where pyæmic abscess of the lungs kills, even if the latter should be the immediate cause of death, which is not necessarily the case.

Treatment after excision.—It is unnecessary, perhaps, to follow these affections further in an essay such as the present. Enough has been said to show the greatest risks from extirpation, and to form a basis for conclusions as to subsequent treatment after this operation. Here, if anywhere, we must be antiseptic surgeons, carrying the principles as far as we can, even to the protection of the air inhaled from contamination and the cleansing of the mouth from particles of food which might remain about the wounded part. Again, we must secure as far as possible against the entrance of blood into the air-passages during operation, remembering that in most cases of cancer of the tongue there has been a foul ulcer in the mouth for weeks or months, and that blood passing from the mouth into the bronchi will bear mixed with it some of the discharge of the latter squeezed out during the operation; also, that blood so inhaled, though possibly pure at first, may become later on a nidus for putrid fermentation by the inhalation of impurities. That such contaminated blood is capable of exciting the most fatal lung inflammation is beyond all doubt, both from clinical observation and experiment. I have seen it produce gangrenous abscesses of the lungs and death in two days in a case operated on by one of my colleagues. In this case the discharge from the fresh wound would hardly have become abundant in so short a time, and as the blood was known to have entered the bronchi freely during operation, so that the patient was only barely saved by laryngotomy and sucking out blood from the trachea, it is fair to suppose that the scattered gangrenous abscesses were caused by the contaminated blood acting directly upon the lung tissue.

Since writing the above, some recently published experiments by Woelfler[1] have come under my notice, which confirm what has just been stated in almost every particular. These experiments (which should be studied by every operator on the mouth or any of the air-passages) were undertaken with the object of determining—1. Whether the lungs were readily inflamed by the injection into the trachea of aseptic fluids, such as milk, wine, solutions of perchloride of iron, or carbolic acid or fresh saliva; 2. Whether the same injection with putrid fluids, such as maceration

[1] *Archiv f. klin. Chir.* Bd. xxvii. p 438.

filth, and rotting ox-blood, mixed with equal parts of water, was hurtful, and, if so, how; 3. Whether the admixture of iodoform with these putrid fluids modified their effects on the lungs. The first point was decided in the negative; the aseptic fluids produced no ill effects on the lungs. The second question was answered in the affirmative; the very same lung affections were produced as those mentioned above, and ran the same course. The result of the third line of investigation was perhaps the most interesting of all. It was shown, namely, that portions of the very same fluids which had produced the most fatal forms of lung inflammation might, on the admixture of a little iodoform with them, be injected with safety into the trachea, the animal appearing to suffer no ill effects from the experiment. These observations of Woelfler and Paneth, conducted with great care, are in many respects confirmed by other observers. They appear to support the conclusions already arrived at from clinical and pathological study on the human being in many important particulars; and, above all, they indicate a means of escape from the terrible dangers of operations on the tongue. We shall see presently that the introduction of iodoform as a dressing for wounds after operation on the mouth has been followed by a great improvement in the results and diminution of the risks of septic lung complications.

How these risks are to be avoided has already been generally considered in speaking of the various excisions of the tongue. But in this direction much remains to be done. For if, in the future, more radical operations on the diseased and surrounding parts than have hitherto been generally in use be demanded for the thorough eradication of epithelioma, as I think will appear from what has been shown above (p. 604), then it must be one of our greatest aims to eliminate this terrible risk of lung complication from direct or indirect infection which has been bound up with the severer operations hitherto. Much has, to be sure, been done lately in this direction, but much more remains still to be done. The true interests of those suffering from cancer of the tongue will not be best served by adopting as our routine practice those modes of extirpation with small immediate risks, but which may be demonstrated to be wholly inadequate to prevent the disease from spreading. We shall have done our best for them only when we have taught ourselves which is the operation most calculated to secure the patient against recurrence of an otherwise inevitably and rapidly fatal disease, and when we have reduced the immediate risks of this operation to a minimum. That the radical operations will eventually be rendered far less dangerous than they are at present we have every warrant for believing from the improvement which has already taken place. And that the direction in which this advance is to be further made will be in the perfecting of antiseptic methods of operating, and of after treatment suitable to wounds of the mouth and the neck, is plain from a study of the facts before us. Kocher's series of 14 cases, with 4 radical cures with no recurrence after 1 year and 2 months, 5 years, 5 and 6 years respectively, and only 1 death, and the way in which he attained to these good results, point significantly in this direction.

Again, as an instance of what may be done in the direction of the after treatment of the wounded mouth, we may refer to our own last 18 cases of the University College Hospital tables (p. 585), of which only 2 died, or 11·1 per cent., the above dangers being now better recognised than in former years when the mortality was much higher. Again, to a series of 17 consecutive cases just published by Woelfler,[1] from the Klinik of Professor Billroth. Of these 17, it is to be noted that not only has none died, but there has been a total absence of all those local or general complications which have been the cause of such a high mortality in the tongue operations, in the same Klinik hitherto. Apparently this improvement is entirely due to the mode of dressing employed for the after treatment of the wounds; for most of the operations in the series have been performed by a method which, as will be seen by reference to von Winniwarter's tables below (p. 617), gave a very high mortality in former years. Out of this series of 17 cases, 13 were extirpations from the mouth, with preliminary ligature of the lingual artery, and there were no deaths;

[1] Woelfler, 'Zur Wundbehandl. im Munde,' *Archiv f. klin. Chir.* Bd. xxvii. p. 419.

whereas in von Winniwarter's table the same operation in 18 cases showed 27·7 per cent. The treatment followed by such excellent results has the merit of extreme simplicity among others. It consists in packing the hollow wound resulting from the removal of the whole or part of the tongue with iodoform gauze, which forms a dressing which moulds itself to all the corners of the cavity, and there 'cakes.' The mass thus formed over the wound adheres to the latter for several days, and cannot be removed without giving rise to bleeding. It is therefore left *in situ* until loosened by the granulation of the underlying surface, which is usually on about the 6th or 8th day. When it comes away the wound is found quite clean, and retains enough of the iodoform on its surface to keep it so until it is healed. This treatment appears to promise much, modified or not as the case may be. I have only had an opportunity of employing it once in a case still under treatment, on which I operated a month ago. But, as far as this case was concerned, the mouth remained perfectly sweet throughout, and the only disadvantage the dressing appeared to have was probably due to my putting too much iodoform on the gauze. The patient appeared to suffer a little from it, and to feel nauseated for a day or two. But this may not have been due, of course, to the drug. In other cases, in which my colleague, Mr. Heath, has used powdered iodoform as a simple dressing without gauze for the wound at the base of the tongue, the results have been equally good. Indeed, it would appear from recent observations that in this strong antiseptic we have discovered the best dressing yet used for the after treatment of excisions of the tongue and floor of the mouth. This will no doubt be employed in various ways, according to the fancy of different surgeons, but if it continue to give as good results as heretofore in preventing septic changes in the secretions on the wound surfaces, but little is left to be desired.

In most of the cases in the series just alluded to, the patients were fed by an œsophageal tube introduced for each meal for several days, and there can be little doubt that this contributed to some extent towards the very good results obtained, the mouth being thus kept quiet and much cleaner than could otherwise be expected.

In several of the cases at University College Hospital we have adopted the plan of feeding our patients with nutritive enemata for the first few days, with a similar object in view, and this has answered well as long as the rectum tolerates the injections. As a rule this is only for a few days, after which it becomes very irritable and expels even small enemata. But in the meantime the wound has probably reached the stage of clean granulation, after which there is less danger of the particles of food sticking in corners of the cavity and provoking foulness. Other surgeons have found this plan to answer equally well.

Washes of various kinds may also be used with some benefit after excision of the tongue, though not equal as antiseptics to applications of Iodoform. Among these Chlorate and Permanganate of Potash, or Carbolic Acid, are perhaps the best, but they often produce severe pain in the wounded part, and the very necessity of constant repetition places them much behind iodoform as a dressing, which requires to be renewed only once or twice in a day. Crystals of Permanganate of Potash have also been used to apply to the wounded surfaces at the first dressing as an escharotic, which was hoped would prevent septic absorption, but it has fallen again into disuse, iodoform dressing replacing it.

Relative mortality of different operations.—A glance at the relative mortality of the various methods of extirpation already enumerated may perhaps now suitably follow the above tables. But here we are met by the great difficulty of classifying the published operations, so few of these are precisely alike, owing to the individual peculiarities of each case and the particular fancy of the various surgeons who have dealt with them. They may be, however, roughly classed in two ways; but we must be on our guard against placing too much reliance upon the hard figures brought out under either mode. Thus they may be arranged—(1) according to the position from which the tongue was removed, and (2) according to the appliance used for the actual severance of the tissues. In the first case the tongue will have been partially or wholly extirpated either (*a*) through the mouth; (*b*) after division of the jaw; or (*c*) from beneath the

latter. In the second case, either (*a*) the wire or chain écraseur has been used, or (*b*) the galvanic écraseur, or (*c*) the simple cutting instruments, knives, or scissors.

In our table of 38 operations for cancer of tongue, the first classification will only go a short way, the great majority of the tongues having been removed through the mouth. But all the more it is of value as showing the relative dangers of the galvanic and the simple écraseur to some extent, though the numbers are small. The operations arrange themselves as follows :—

	Total	Died	Mortality, p.c.
Galv. écraseur from the mouth	13	5	38·4
,, after division of jaw	4	3	75·0
Wire écraseur from the mouth	12	1	8·3
,, from hyoid incision	5	1	20·0
Scissors from mouth	2	—	—
Knife and cautery from mouth	1	—	—
Knife after division of jaw	1	—	—
	38	10	26·3

Thus it will be seen that out of 17 cases where the galv. écraseur was used, 8 died, 6 of the deaths being due to the direct lung affections described above, the remaining 2 dying respectively of œdema glottidis and ordinary septicæmia. Of 17 cases in which the wire écraseur was employed, 2 died, one of surgical pneumonia, the other of ordinary pyæmia, with abscesses over the spleen and renal infarcts, the lungs being healthy.

Billroth's two series of cases are classified in somewhat the same way as above, except that there are two additions not represented among our cases and that operations for recurrence are included. The latter fact of course lowers the mortality relatively, for in this country second operations are not usually counted in this way in statistics. In examining the table below, it must be remembered that the first series (von Winniwarter) includes only 42 patients, and the second (Woelfler) 44. The statistics, however, are particularly valuable as coming from the experience of one operator and his assistants in one hospital :—

	von Winniwarter			Woelfler			Mortality total of combined tables
	Total	Died	Mortality	Total	Died	Mortality	
Extirpation from the mouth, including 7 (von W.'s table) by galvanic écraseur	21	2	9·5	20	5	25·0	17·0
				No galvanic écraseur			
Extirpation from the mouth after ligature of lingual artery or arteries	18	5	27·7	20	2	10·0	18·4
Extirpation from supra-hyoid region	13	6	46·1	4	—	—	35·2
Extirpation with section of jaw; (1) 'temporary resection'; (2) removal of part of jaw	2	2	100	6	1	16·6	37·5
Total	54	15	27·7	50	8	16·0	22·1
Extirpation of glands for recurrence	3	1	—	—	—	—	—
Extirpation of tongue by pharyngotomy incision	—	—	—	1	1	—	—
Total	57	16	28·0	51	9	17·6	23·1[1]

On carefully examining von Winniwarter's series of cases in detail, I find that they cannot be fairly compared with ours in any other way except in one point—namely,

[1] Or 29·0 on 86 individuals.

the excision by the galv. écraseur from the mouth. Of these there were 7, of which 2 died, or 28·5 per cent., results not quite so bad as where this instrument was used at our hospital in a larger number of cases, but still pointing to the risks attending on its employment. Apparently the wire or chain écraseur was not used in any of Billroth's cases, so that we have no way of contrasting his with ours in respect to the desirability of its employment. It may be mentioned further that in Woelfler's series where extirpation took place from the mouth, as in the first group of the above table without preliminary ligature of the lingual artery, the parts were cut in a large proportion of cases with a curved scissors by a method since independently advocated by Mr. Whitehead as possessing many advantages.

But one point is quite clear from all these analyses—namely, that though those operations for well-marked disease on the tongue which require extensive dissection along the floor of the mouth and side of the neck, with or without division of the jaw, have hitherto been the most dangerous of any, they have given the best results (where the patient has survived) as to non-recurrence or length of immunity from recurrence. And when we come to inquire into the nature of the risks connected with these more extensive operations we find them nearly all of one class—they are almost always due, namely, to septic infection of one kind or another. When the diseased tongue has been removed by the sub-maxillary method at its base, the dangers of shock of hæmorrhage into the air-passages or otherwise have not been encountered. The deaths resulting have in almost every instance been due to septicæmia, pyæmia, or surgical pneumonia. This being so, we may hope that the day will soon come when, having learned how to operate on this particular region aseptically, and in the after treatment to guard against putrid infection, we may proceed fearlessly to the more deliberate radical extirpation of the diseased tongue and infiltrated parts around, and so save our patients from recurrence, which so frequently follows the other methods that they almost deserve the name of the palliative operations. Such an elimination of the dangers of sepsis has gradually taken place in the history of other grave procedures of late years, thanks to the teaching of Mr. Lister in particular, and also to a general advance of surgery all along the line. And it is not too much to hope that it is quite possible here too. We now know our enemy and his various modes of attack in great measure. If we can meet him and foil him, we shall have achieved another triumph in surgery. We shall have rescued a large and possibly increasing class of patients from one of the most painful, distressing, and rapidly fatal forms of cancerous disease known. That we are justified in risking a good deal in the meantime in the pursuit of such an end, no one familiar with the history of these cases can for a moment doubt. The fact of the disease being so inevitably and rapidly fatal is enough for this. And we are further justified, after a considerable number of years' experience, by the knowledge that we have already achieved much, however much still remains to be done. That there is a great and useful future for the more extensive and radical operations on the tongue *and the parts about its root*, we may venture now to predict with confidence.

Palliative treatment for cancer of the tongue.—And though this be all true, it in no way lessens the force of the conclusion ventured on at the commencement of this section—namely, that the greatest of all advances in the treatment of cancer of the tongue is to be made in the direction of early diagnosis and early and decided operative interference while the disease is still purely and beyond all doubt local.

There now remain but a few words to be said as to the palliative treatment of cancer of the tongue, when, for any reason, excision of the organ is not undertaken.

The first great evil which the patient will wish to be relieved from will be the pain, which in many cases is almost intolerable. This is not present in every case of the affection, however, of cancer of the tongue; and I have seen cases in which even advanced disease produced but little discomfort. Still, the instances in which it is present, and they are many, call for relief urgently. The pain is usually felt, not only in the organ itself, but also frequently over nearly the whole distribution of the fifth nerve on the affected side. In such a case, anodynes will give only partial and temporary relief, and something more must be done. Here the division of the gustatory

nerve, proposed many years ago by Hilton, has been found of much benefit by several surgeons. The mode of performing this operation, defined later by Moore,[1] is perhaps better than that originally practised by Hilton, and is now usually followed. A curved bistoury is passed through the mucous membrane of the floor of the mouth, at a point corresponding to and in the direction of a line drawn from the last molar tooth to the angle of the jaw, and when it has reached below the ridge of the bone which corresponds to the nerve, it is pressed firmly outwards against the jaw and made to cut upon the latter as it is withdrawn. In this way the nerve is severed as far back as is necessary. In Moore's cases the relief to the pain was great and lasting, and the patient's condition was much improved.

This operation has another good effect, hardly less marked—namely, an arrest of the profuse salivation which in many cases renders a patient's life very miserable, and is besides very exhausting.

The next trouble which will call for treatment will be the intense fœtor arising from the decomposing débris of the ulcer with the saliva secreted over it. This is often acutely distressing to the patient and his friends, and may lead eventually to surgical pneumonia if not checked, as in two of Moore's cases. This is best treated by the sprinkling over the ulcerated surface, cleaned previously as far as possible, of a small quantity of powdered iodoform. If the growth have been fairly dried beforehand, this will cling and stick to the surface for a long time, even days, and most effectually control all decomposition, as I have seen in more than one case. If this be not to hand, washes of Condy's fluid, of Chlorate of Potash, or Carbolic Acid in solution may be used with good effect. But these are troublesome from the necessity of constant repetition, and often from the aggravation of the pain which they often produce. The introduction of Iodoform into the treatment of such cases has therefore been a great advance, for there is no objection to its use if not too freely applied, and its effect is slightly anodyne as well as strongly antiseptic.

Again, patients with advanced lingual cancer not unfrequently suffer from repeated bleedings from opening up of the arteries of the tongue. Here we are frequently driven from one strong local hæmostatic to another, until at last ligature of the lingual artery has to be resorted to. This will generally be effectual, but is by no means an easy operation if, as is usual in advanced cases, the side of the neck be the seat of much induration around infiltrated glands. Hence an extra reason, if one were wanting, for the performance of early excision. For we know that in the vast majority of cases the disease once removed from the tongue and floor of the mouth does not recur there again, but in the glands, and thus the risks of hæmorrhage are eliminated in the further course of the case.

Finally, the pressure effects of the recurrent growths in the neck may have to be considered. Thus we may be called upon to feed a patient with a catheter passed down the œsophagus past an obstruction from enlarged glands, as in one of our latest cases at University College Hospital; or the question of the propriety of gastrotomy may have to be entertained if this fail. But these are matters of general surgery, and need not be more than alluded to here.

In conclusion, it may be well to recall the fact once more that extirpation of the tongue for cancer removes several of these sources of distress just alluded to, to which patients unoperated on are almost inevitably exposed—namely, pain, fœtor, salivation, and the swallowing of discharges, and life is thus rendered at least tolerable, if it is not prolonged.

ARTHUR E. BARKER.

[1] *Trans. Med.-Chir. Soc.* vol. xlv. p. 47.

DIPHTHERIA AND CROUP.

Diphtheria.

A FEW years ago the name of diphtheria was unknown in England. It is highly probable that the descriptions of some of our older writers refer to this disease, which no doubt appeared then, as now, in an epidemic form; but for a very long period England had been free from its presence, and our acquaintance with its symptoms and consequences was, till recently, chiefly derived from observations made in France, where it had been known and studied for a number of years.

The first observations which, in this country at least, led to a true understanding of the nature of that false membrane which so eminently characterises diphtheria were made with reference to sporadic croup by Dr. Home,[1] about the middle of the last century. He first recognised the existence of a mass of fibrine, moulded to the form of the subjacent structures, and adherent to the mucous membrane, but lying quite upon its surface, 'and generally lying loose upon it.' Prior to this date such exudations were supposed to be part of the membrane itself, detached in the form of a slough.

In 1801 Dr. Cheyne published his essay on 'Cynanche Trachealis, or Croup,' in which he described clearly a membranous laryngitis, and figured the post-mortem appearance of the parts concerned.

From this time the word 'croup' began to be applied to that form of inflammation of the air-passages which is attended with the production of a false membrane.

In 1821 Bretonneau,[2] in his Memoirs read before the French Academy, called attention to an epidemic disease, in which occurred a specific inflammation attended with the formation of false membrane, chiefly upon the mucous membrane of the throat and windpipe, but also upon excoriated skin. This disease he called first 'diphtherite' and subsequently 'diphtherie;' he considered it due to a specific virus, and believed that membranous croup was one of its manifestations.

Thus arose the name 'diphtheria,' which has ever since been employed to designate the disease of which Bretonneau gave the first scientific account, the symptoms of which have undergone so little change, that his report continues to be a very faithful picture of the usual forms which it presents, although his theory of the local character of the disease has been now almost entirely abandoned.

Definition.[3]—Diphtheria may therefore be defined as an acute specific febrile disease, contagious and often epidemic, the special characters of which are—(*a*) the formation of false membrane, chiefly upon the mucous membrane of the throat and air-passages, but also upon excoriated skin surfaces; (*b*) a grave and rapidly increasing depression and anæmia; and (*c*) in the later stages, evidences of disturbed innervation.

It attacks persons of all ages, but prevails most among children under seven years of age. Of adults, those are most prone to diphtheria who are suffering or convalescing from other diseases or from injury. Among children it is not uncommonly associated with measles, and with enteric and scarlet fevers. It shows no preference for either sex.

[1] *An Inquiry into the Nature, Causes, and Cure of the Croup*, by Francis Home, M.D.

[2] *Memoirs on Diphtheria*, published by the New Sydenham Society.

[3] For definition of the word 'diphtheria,' the reader is also referred to the 'Report of the Scientific Committee' of the Medico-Chirurgical Society, 'On the Relations of Membranous Croup and Diphtheria,' *Med.-Chir. Trans.* vol. lxii. p. 30. Frequent use of this most valuable Report has been made in this article.

The most common source of the disease is doubtless contagion, and as with other inoculable diseases which are also certainly conveyed from the sick to the healthy through the atmosphere without actual contact, so with this there seems every reason to believe that in certain investigated instances the infection has been so propagated; and we can hardly withhold our assent to the proposition that it may be so in all, although it is not always, perhaps not often, possible to trace the source of the infection, and the means of its transmission.[1] Filth and bad drainage are, however, certainly favourable for its development.

Symptoms.—The incubation period of diphtheria is not certainly known; it appears to vary between a few hours and a week. At a variable period then, but usually a few days after exposure to the poison, the person attacked shows signs of general illness and febrile disturbance, accompanied usually by sore-throat, and often by some tenderness of the lymphatic glands at the angle of the jaw.

Diphtheritic fever.—The primary action of the poison when imbibed into the system is an alteration in the character of the blood. This we infer, in the first place, from the sense of malaise, and the febrile action, which, in some instances very slight indeed, but in some very severe, can be traced before any local manifestation occurs. This fever alone may kill, and when it does so, it is always by its assuming an asthenic character; the patient either becomes daily weaker, and ultimately dies of exhaustion, or the case is marked by a low muttering delirium, with a tendency to slough about the inflamed mucous membrane, excessive prostration, and rapid sinking; in either case the pulse is feeble and very frequent. It is to be borne in mind that this is the invariable character of the disease, however inflammatory the fever may in the first instance seem to be. In the second place, we infer the existence of blood-poisoning from the occasional appearance of purpura and sanious exudations in fatal cases, and the constant sequel of intense anæmia, even in comparatively mild cases, during convalescence.

These peculiarities are very striking, because the depression resulting from the attack is out of all proportion to its severity, and even when the fever is manifestly asthenic in its character, the subsequent weakness seems very much greater than might have been anticipated, and may end in a gradual but total failure of vital power after all danger had seemed to be at an end.

The fibrinous exudation.—The next immediate effect of the poison is the local action on the mucous membrane of the throat, which looks from the first swollen and red, as if it were the seat of active inflammation. And such no doubt it is; but it is a specific, and not an ordinary inflammation. It is quite different in its character and consequences from the ordinary inflammation of mucous membrane, and bears some analogy to that which is more commonly restricted to serous membrane; differing from it most, perhaps, in its tendency to localisation. We are all perfectly familiar with the rapid spread of the inflammatory blush, from a single point, over the whole involutions of the peritonæum, with its sticky, glazy, and fibrinous exudation; we see the same exudation forming a thick shreddy coating all over the heart or covering the entire surface of the pleura. In diphtheria we have the same character marking the exudation, but the parts involved are not coextensive with the limits of the membrane. In many cases the patches of lymph are few and small, and the inflammation is confined to the back of the throat. In a certain number of instances, the trachea, and even the bronchi, are involved; not unfrequently the membrane lining the nares is attacked more or less extensively; more rarely the exudation travels down the œsophagus; and in a few cases it reaches up the lachrymal duct to the surface of the eye. The laws of its extension seem to be much more in harmony with those of mucous than of serous inflammations, and there is but little difference in this respect between diphtheria and ordinary sore-throat, which may either be limited to the fauces, or may be the commencement of a catarrh ending in general bronchitis. The character of the exudation varies much in the same manner. When the extent of inflamed surface is small, the effusion is scanty, and the deposit of fibrine of less

[1] See Dr. W. Ogle's 'Remarks on the Dissemination of Diphtheria,' *St. George's Hospital Reports*, vol. ix. p. 704.

thickness and consistency; when the inflammation is more extensive, it is generally also more intense, and the effusion is thicker and denser, deeper and firmer. But there is no absolute rule in this respect. The fibrine is exactly analogous to that which usually covers inflamed serous membrane, presenting not only the same general appearances, but also the same microscopical elements.

The ordinary consistence of the effusion is such that it is often called false membrane; but it is sometimes scarcely more cohesive than paste, and contains more granular matter and cells than fibre in its structure. The mucous membrane on which it rests is almost always redder than usual; and when the fibrinous layer is removed, it looks raw and irritable, as if denuded of its epithelium; it is generally also dotted over with bloody points where the adhesion has been closer or the exudation has entered the mucous follicles and torn the tissue in its removal.

The diphtheritic exudation does not, however, always commence upon the throat; it may attack primarily the larynx, the nares, or the posterior surface of the soft palate, situations where its presence would be less obvious and where its discovery may be difficult. It may also be seen on the skin when the cuticle has been removed by a blister; and it is alleged that the contagion of the disease has spread in this way to persons who have had blisters applied while living in rooms where others have been suffering from diphtheria. Any ulcerated or abraded surface, in persons labouring under the disease, may similarly become coated with false membrane; and not unfrequently the mucous membrane of the pudenda in female children is the seat of a similar exudation. Suppuration of an unhealthy kind sometimes attacks the mucous membrane beneath the exudation, which melts away with a gangrenous odour, leaving a slough or a foul ulcerated surface behind; and then the whole course of the disease may be changed, and the patient may fall into that low typhoid condition which is believed to be caused by the absorption of unhealthy inflammatory products.

The mere fact of exudation having taken place, apart from its value as an indication of the severity of the attack, claims our most earnest attention, from its occasional bearing on the issue of the case as a local complication. It is not the extent of surface attacked which excites apprehension, but the importance to life of the narrow chink through which air is drawn into the lungs, and the readiness with which a very small amount of thickening, or a very slight deposit on the membrane covering the chordæ vocales, may obstruct the entrance of air, and cause death by suffocation. It would appear that in different epidemics the tendency of the inflammation to spread to the larynx has varied very greatly; sometimes a majority, sometimes but a small number of the deaths resulting from this circumstance.

There is no doubt, however, that the tendency to the laryngeal implication is in proportion to the youth of the patient, and the mortality may be said to have the same relation to age. The gravity of laryngeal diphtheria may be estimated by the statement of the Committee of the Medico-Chirurgical Society that 'the mortality where laryngeal membrane is found, whether with or without faucial, is 90 per cent.'

The character of the symptoms will obviously depend to some extent upon the locality of the diphtheritic membrane. If the tonsils, palate, or pharynx be the part attacked, there will be painful deglutition, tenderness and swelling of the glands near the angle of the jaw, and perhaps deafness, or suppuration of the middle ear. Post-pharyngeal abscess also sometimes forms, and adds to the difficulty of swallowing. If the nares are the seat of the exudation, coryza and foul discharge from the nose will be present, while the laryngeal complication soon makes itself evident by rapidly increasing dyspnœa and all its attendant distress. When the laryngeal symptoms occur, they are of a gravity which at once makes them the prominent feature of the disease. The child becomes increasingly restless; the respiration stridulous, and the cough of metallic harshness; the voice becomes whispering or is lost altogether; there is an expression of great anxiety; the complexion becomes livid, and the pulse rapid and weak. An important symptom, indicative of the obstruction to the ingress of air to the lungs, is the recession of the soft parts of the chest with each inspiration; this is the more marked the greater the respiratory efforts. The urgency of the

symptoms may be temporarily relieved by the expectoration of false membrane, or aggravated by recurring spasm of the glottis. The difficulty of the breathing induces great exhaustion, and, as the disease progresses, the patient is less able to maintain the effort. The respiration becomes more shallow, the drowsiness more overpowering, and death occurs either in a sudden spasm of the glottis, or in a condition of coma or exhaustion. In the course of these events large portions of the lungs may become collapsed, or consolidation may occur from lobular pneumonia.

Albuminuria.—Another symptom of common occurrence in the severer forms of diphtheria is an albuminous state of the urine. As in scarlatina, the presence of albumen is simply due to congestion of the kidney; and we conclude that in some way or other the vitiated or poisoned blood stimulates the capillary vessels so as to produce this state of congestion; but we have as yet no clue to unravel further the mystery. In the one disease the urine presents no trace of albumen during the acute stage, the congestion only appearing with the desquamation of the cuticle after the febrile condition—the scarlet fever, so to speak—has passed off; in the other it commences at a very early period of the disease, generally lasts only for a few days, and does not cling to the patient during convalescence, as is the case so often in scarlatina. It causes no surprise that we cannot explain these peculiarities, since we have no idea why the complication exists at all, when it does not accompany any other form of sore-throat, nor to the same extent any other febrile disorder.

Paralysis.—Another phenomenon accompanies or rather follows upon attacks of diphtheria with sufficient frequency to establish a certain relationship between them; but as yet we can only affirm that paralytic affections may be apprehended after partial convalescence from diphtheria—after, indeed, the throat is perfectly well, and nothing seems wanting to recovery but the due performance of the nutritive functions. This may be the gravest of the sequelæ, since patients may die of paralysis of the heart[1] when no lesion whatever can be traced after death. The paralysis most frequently affects only the muscles of deglutition and of speech, but does also sometimes include nearly all the muscular tissues throughout the body; the sight becomes impaired through loss of the adjusting power of the eye,[2] the pulse fails, apparently from diminished nervous energy in the heart, the legs and arms become partially powerless, and sensations of tingling and numbness are complained of, or actual anæsthesia exists.

Epidemics of diphtheria vary much in severity, and wherever the disease is prevalent there commonly occur a considerable number of cases of sore-throat, attended with an unusual amount of depression, and followed by anæmia, cases which it is fair to presume have their origin in a diluted or mild infection with the diphtheritic poison.[3]

Treatment.—The fatal termination of an attack of diphtheria may follow either as a remote or immediate result of the fever itself, or in consequence of the obstruction of the larynx by local exudation; and the treatment must vary as the one or the other of these symptoms is the predominant feature of the case. Like the other acute specific diseases, diphtheria must be treated on general principles, inasmuch as no specific remedies have yet been discovered which have the power of destroying the blood-poisons on which they severally depend.

1. In some rare cases the patient is at once prostrated by the severity of the fever; he has a brown tongue, a quick and feeble pulse, probably purpurous spots on his body, or a sanious discharge from the nose or fauces, and occasionally muttering delirium. Such cases rarely show any signs of rallying; and the freest use of stimulants affords the only chance of saving the patient or enabling him to recover from the shock of the attack.

2. If not thus prostrate from the very first, yet generally from an early period the tendency of the disease is to assume a low or asthenic type, and to produce a depression, which must be met or even forestalled by the administration of stimulants. The difficulty of swallowing must not be permitted to interfere with the quantity of

[1] *Diphtheria, its Symptoms and Treatment*, by William Jenner, M.D., pp. 42–59.
[2] *Diphtheria*, by E. H. Greenhow, M.D., p. 229.
[3] See also Dr. W. Ogle, *op. cit.* p. 702.

nourishment taken; patients who escape the first severity of the disease are still exposed to the danger of a lingering convalescence, or a gradual exhaustion of the vital powers; and hence the importance of a sustaining mode of treatment, and of the careful avoidance from the outset of all lowering measures. Chlorate of potash, hydrochloric acid, quinine, and muriated tincture of iron, are the constitutional remedies on which, according to the testimony of most writers, the greatest reliance is to be placed; but if, as is often the case, there is much difficulty in their administration, it is to be remembered that food and stimulants are of more importance than physic.

3. The occurrence of unhealthy suppuration or of pyæmic symptoms gives of course increased gravity to the case, and calls for increased activity in the administration of stimulants and tonic remedies. Abscesses should be opened early and dressed with antiseptic applications. In such cases opium and quinine are sometimes very useful, and, indeed, the extent to which both opiates and stimulants are borne is often surprising.

4. The local disorder claims our attention more especially when it spreads towards the larynx and trachea. The idea that the extent of the exudation was the cause of the severity of the symptoms has been entirely abandoned, and with it that meddlesome activity which deemed it necessary to apply caustics or astringents several times a day to the throat. An abraded surface, whether of cuticle or of mucous membrane, is speedily covered with the diphtheritic exudation in the severer forms of the disease, even when no contact of parts is possible; and it would seem perfect madness to apply an escharotic which tends to denude the adjacent membrane of its epithelium, and prepare it for the fibrinous exudation which is certain to take its place. The application must be astringent, not escharotic; a stimulant to the diseased surface, not a destroyer of its vitality. The occasional sponging with a solution of the perchloride of iron, or a very dilute mineral acid, or a weak solution of lunar caustic; the use of atomised fluids containing detergents or astringents, such as sulphurous acid, myrrh, or benzoin; inhalations or gargles of a similar kind; these may assist in preventing the spread of the exudation, or in stimulating the parts to a more healthy action; but the power of such means is allowed on all hands to be very limited.

When the larynx is also involved in the exudation, dyspnœa and insufficient aëration of blood add very materially to the sufferings of the patient and the probability of a fatal termination; and the question naturally presents itself whether any, and how much, benefit may be anticipated from the operation of tracheotomy. It is by no means easy to give in few words a definite answer to this inquiry, or to lay down rules which may be sufficient to guide the practitioner in deciding on his course. If we turn to statistics, we find that the fatal termination is not averted to any great extent, although in all probability some lives have been saved by the operation which must otherwise have been lost. But it is manifestly impossible to frame a series of cases in which it has not been performed, which shall be an exact counterpart to those operated upon; and without such a basis of comparison, the knowledge of the exact number of deaths and recoveries after operation is valueless. It is indeed asserted that of late years the mortality in France after tracheotomy is not nearly so great as formerly; but this may depend not so much on the results being more favourable, as on a more hopeful series of cases being selected. In such circumstances we must be guided by general principles, and the rules for our guidance must be admitted to be based partly on conjecture. It may be assumed then, first of all, with tolerable confidence, that when the general symptoms indicate that the attack is comparatively mild, while the danger of suffocation is imminent, tracheotomy does give a chance of life in cases otherwise all but hopeless, and that it certainly does give prompt and certain relief to the suffering immediately caused by dyspnœa, than which nothing is harder to bear. But no surgeon ought to undertake the operation, even in such circumstances, without fully explaining that relief, and relief only, from impending suffocation is its object. Secondly, when the dyspnœa is less intense, it becomes a question whether the relief to the breathing may not help forward the process of cure which nature is working out; or it may rather be said,

whether the existing amount of dyspnœa does not materially hinder the recovery, and render it more uncertain. The French surgeons are disposed to answer in the affirmative; and the opinion is shared by many among ourselves; but the practice is clearly not one that can be urged as necessary in the present state of our knowledge. Thirdly, in the very severe forms of the disease, we may well pause before recommending the operation, because it is no longer a question of the possible saving of life, but one merely of giving temporary relief. In addition to which, we must remember that the operation may entirely fail to give relief in consequence of the trachea and bronchi being blocked up by false membrane. In such cases it can only be justified by intense dyspnœa and impending suffocation, and by the earnest longing of the patient, or the friends, to have something done to procure relief. Could we know with any degree of certainty how far the exudation extended into the trachea and bronchial tubes, we should have most valuable information to guide our decision. Auscultation should with this view always be carefully practised; but it must be confessed that the determination is a matter of extreme difficulty, and one in which the most experienced stethoscopist may fail to elicit any accurate or trustworthy information. If, however, the operation is determined upon, it is vain to defer it until exhaustion is extreme, or the lungs are hopelessly damaged.

5. When the urgent symptoms are passed, convalescence will be aided by the administration of iron, and by the free admission of fresh air and sunshine. All active exertion must for a time be avoided, and only resumed gradually and with caution. Care in this respect is especially needful should there be any symptoms of paralysis.

6. During the prevalence of the epidemic many slight cases occur, which assume more or less its specific characters, and are marked by the presence of small shreds of lymph on the fauces. An ordinary sore-throat at such times does not follow its usual course, but without manifest exposure to infection is somehow assimilated to diphtheria. These generally require no special treatment, and will in all probability end in recovery without the aid of medicine. Such cases should, however, be removed into a pure air, and carefully protected from all depressing influences.

Croup.

The word 'croup' has long been in use, both among the common people and by physicians, to signify an acute febrile disease of children, attended with difficult breathing due to obstruction of the windpipe. But the exact nature of the disease has not been well defined; for it has been observed that the symptoms special to the larynx may have varying and extremely different concomitants, and that in some instances they lead to a rapidly fatal end, while in others they terminate in speedy recovery. It has thus become manifest that the symptoms which gave rise to the word 'croup' may be a part of several distinct diseases, and the relation of the symptoms to the diseases has been a matter of much uncertainty. Therefore, as it is desirable that our terms should only imply as much as we know, it will be both convenient and reasonable to adopt the suggestion of the Committee of the Medico-Chirurgical Society,[1] 'that the term "croup" be henceforth used wholly as a clinical definition, implying laryngeal obstruction occurring with febrile symptoms in children.' Using the word in this sense, it will be found that cases of 'croup' are separable into two classes, distinguished by the presence or absence of false membrane, and that although this criterion may not always be available (that is to say, it may not always be possible to determine the existence or not of false membrane), yet that there are certain broad and important distinctions between the two groups of cases, which give to each of them a very different signification.

The distinctions between membranous and non-membranous croup are chiefly these :[2] First, that the membranous is enormously more fatal than the non-membranous disease, so that, speaking generally, it may be said that nearly all of the first class

[1] See *Report of Med.-Chir. Committee, supra cit.* p. 23.

[2] *Op. cit.* p. 33.

die, and nearly all of the second class recover. Second, the membranous affection shows no preference for sex, but the non-membranous is much more common among male children. Third, the onset of the membranous form of croup is much less sudden than of the non-membranous; in the first class of cases the patient usually shows signs of considerable illness for a day or two before the commencement of the laryngeal symptoms, and in many of this class the croup is consecutive to membranous inflammation of the throat or other parts; in the second class the attack is apt to come on suddenly in the night, without any premonitory symptoms, or after only those of slight catarrh. Fourth, in the cases which recover, the duration of the membranous is greater than of the non-membranous disease. Fifth, non-membranous croup is apt to recur, which is not the case with the membranous form. Sixth, there is a much greater tendency to albuminuria in membranous than in non-membranous croup.

Of membranous croup, by far the most common cause is the contagion of diphtheria, although probably it may arise from foul air and water, or other unhealthy surroundings, and also in association with measles, scarlatina, and typhoid fever, 'independently of any ascertainable exposure to the special diphtheritic infection.'[1] It appears also that membranous inflammation of the air-passages may occasionally follow exposure to cold, and accidental injuries, such as the inhalation of steam, or the introduction of a foreign body into the larynx; but cases of this kind are so rare that they do not call for separate consideration. All that need be said therefore concerning membranous croup will be found in the preceding section upon 'Diphtheria.'

Non-membranous croup is a disease of childhood, and may be either inflammatory or spasmodic. This division into inflammatory and spasmodic croup is necessary for the separation of two groups of the non-membranous disease which have an entirely different origin; nevertheless it is needful to point out that with the inflammatory symptoms spasm may be combined and moreover play a prominent part; and, on the other hand, that the spasmodic affection may be attended with some degree of pyrexia.

With these explanations, then, as to the limits of the criteria, cases of croup may be classified as follows:—

- Croup
  - Membranous
    - 1. Due to diphtheritic contagion. — No contagion traceable.
    - 2. Due to foul air or other unhealthy surroundings. — No contagion traceable.
    - 3. Associated with certain specific fevers. — No contagion traceable.
    - 4. Following exposure to cold. — Very rare.
    - 5. Following injuries. — Very rare.
  - Non-membranous
    - 1. Inflammatory—catarrhal.
    - 2. Spasmodic—nervous.

Inflammatory non-membranous croup is a catarrhal affection of childhood, occurring chiefly in cold weather, and especially during the prevalence of east winds. Boys are more prone to it than girls, and a child who has once suffered from its attack is liable to a recurrence. It usually comes on in the night; the child may have gone to bed apparently well, or more commonly with some slight catarrhal symptoms, when, after a few hours of restless sleep, it wakes in a condition of acute fever, and with a hard dry cough which has a very peculiar sharp ringing sound dependent on the changes which, from the first, occur in the larynx and trachea. The sound of the cough is so remarkable, that when a child produces this brassy tone in coughing, the attendant is tempted to conclude, without further inquiry, that the disease is croup. There is very generally no difficulty in swallowing, any feeling of soreness of throat being confined to the windpipe, and not reaching the fauces. The

[1] *Med.-Chir. Report, op. cit.* p. 31.

breathing is always hurried, partly as a consequence of the febrile state, partly because air enters the lungs with difficulty. As the disease proceeds this difficulty increases, and the dyspnœa recurs in paroxysms, which become every hour more distressing. Such paroxysms often follow a fit of coughing, but occasionally come on without any apparent cause. These symptoms are due to inflammation of the larynx and trachea, the mucous membrane of which is swollen and vascular, and in the first stage of the disease dry; subsequently a more or less abundant secretion occurs of tenacious mucus, or muco-purulent fluid. Towards morning there will probably be some abatement of the symptoms, which, however, increase again with the approach of night; but after a day or two, if there be no complication, the severity of the attack usually diminishes, the fever passes, and the child is left somewhat weak and hoarse, but not otherwise ill. For some time, however, there will be a liability to a return of hoarseness after any unusual vocal effort, and to a croupy cough on exposure to cold.

The disease usually ends in recovery, but death may occur in one of the paroxysms of dyspnœa, owing to spasmodic closure of the glottis. Complications moreover may arise; for instance, in a rickety child serious collapse of the lung may occur; or the laryngeal and tracheal affection may pass on to bronchitis and lobular pneumonia, each with their attendant dangers, and a corresponding increase in the gravity of the case.

Treatment.—The first essential in the treatment of this disease is, that the patient be placed in a warm, moist atmosphere. For this purpose the bed should be surrounded with curtains, within which should be directed a jet of steam from a bronchitis kettle, or some similar apparatus. If the child is robust, a few leeches may be applied over the top of the sternum. Warm fomentations or poultices should be placed over the throat, and a warm bath may with advantage be given at the outset. The bowels should be cleared by a mercurial purge; and salines, antimony, and bromide of potassium administered. If the difficulty of breathing increase to a serious extent, great relief may be obtained by antimonial emetics. The antimony should then be given, not in small doses, but in sufficient quantity to produce vomiting, which may thus be provoked from time to time as seems necessary. Perhaps, if given with ipecacuanha, a smaller dose of antimony suffices. If there be much spasm, opium and hyoscyamus are to be recommended. It is of great importance to keep the bowels clear, and to administer only the most digestible food. The presence of undigested food in the stomach is very apt to aggravate the laryngeal spasm. We must not forget, however, that children are easily depressed, and that difficult breathing is in itself extremely exhausting; the character of the pulse and the general aspect of the child must therefore be carefully watched, and any signs of failing power noted and acted upon. The prolongation of extreme dyspnœa, or the recurrence of severe spasm of the glottis, would call for tracheotomy.

Spasmodic croup, child-crowing, or laryngismus stridulus, depends upon a spasm of the glottis having its origin in some nervous irritation. It is usually but a part of a convulsive disorder affecting other muscles besides those of the larynx. It is especially common among rickety children, and among those that are teething or have been recently weaned. In those that are prone to its attacks, the spasm is especially liable to occur during the prevalence of catarrhal symptoms. The affection is characterised by the suddenness of its onset: a child may seem perfectly well, with the exception perhaps of a slight catarrh or some sign of rickets, when, without any warning, and frequently just as it wakes from sleep, it makes a long inspiration, attended with a loud crowing sound, and with much effort. As the sound comes to an end, the effort may cease, and the child soon be comfortable again; or, on the other hand, the face may become livid, the lips blue, and suffocation seem imminent. At last the spasm ceases, breathing again begins, the colour returns, and the child bursts into a cry and is soon itself again. Death may, however, occur during a spasm, and this has been known to happen at its first occurrence. The attack may be excited by cough, by crying, by a cold draught, or other eccentric

irritation. At the same time there is often adduction of the thumb, abduction of the great toe, or other spasmodic muscular contractions.

The *treatment* of this affection consists of the removal, when possible, of any source of nervous irritation; and in attention to the particular diathesis in connection with which it occurs. Anti-spasmodic remedies, especially bromide of potassium and chloral, are of great use during the prevalence of the attacks. On the occurrence of a severe spasm, chloroform should be administered if available, or the child should be placed in a warm bath; the mouth should be opened and the tongue pulled forward; or the head should be thrown back and the chin raised: or, finally, if the spasm continues, an opening should be made in the trachea.

A. W. Barclay, 1870.
Warrington Haward, 1882.

DISEASES OF THE NOSE.

I. AFFECTIONS OF THE EXTERNAL PARTS.

THE nose is especially liable to the various diseases of the skin which occur upon the face, and is very apt to be the part first attacked by morbid processes which eventually extend to the adjacent tissues.

Thus lupus is a disease which commonly commences upon the nose; but it is by no means confined to that situation, nor has it any special characters therein, excepting that, from the anatomical arrangement and prominence of the feature, its destructive results are peculiarly disfiguring.[1]

Rodent ulcer and epithelioma when they attack the nose do not differ either in their manifestations or treatment from these diseases as seen upon other parts.[2] The various kinds of nævus are not unfrequently seen upon the nose, and should be treated as on other parts of the face.[3] For the subcutaneous form I have found the operation of dissecting out the growth, after turning back the requisite flap of skin, excellently adapted for this situation, as it leaves only a linear scar which is scarcely noticeable.

Billroth describes and figures a remarkable case of arterio-venous angioma which followed a fall in which the nose was struck.[4]

The only disease of the skin which needs especial mention in connection with the nose is *acne rosacea*, for this affection, though not confined to the nose, leads in its advanced stage to a form of integumentary hypertrophy which is peculiar to the part. This differs from the other forms of acne in that the sebaceous follicles are not primarily affected. It commences as a red shining spot in which the capillaries of the skin are seen to be dilated and injected; there is no swelling, but usually a sense of irritation and heat is felt in the part, which is increased by stimulating food and changes of temperature. The tip, or one side of the nose is often the only part affected; but in some cases the greater part of the skin of the face presents an unnatural degree of redness, and numerous dilated and congested vessels are seen ramifying upon the surface, which give to the countenance under any excitement a dusky purple hue.

As the disease progresses, the sebaceous follicles usually, but not always, become involved; indurated tubercles form, over which the skin is of a livid purple, and which sometimes undergo slow suppuration; or there may be merely an increased secretion of sebaceous matter producing a greasy condition of the affected surface. This form of the disease may persist for years, and in women, who are much more prone to it than men, does not usually give rise to further changes.

In men, however, especially in those who have been addicted to over-feeding, an infiltration and hypertrophy of the cutis and sebaceous follicles often ensues ('acne hypertrophica' of some authors), which leads to the formation of the irregularly lobulated and pendulous masses which frequently disfigure the nose. These growths, sometimes incorrectly called 'lipomata nasi,' do not consist of fat, but are due to hypertrophy of the cutis vera and sebaceous follicles, with dilatation of the small veins; they are of firm texture, and usually of purple colour; some are sessile and wart-like, others more or less pendulous.

The severer forms of acne rosacea are commonly attributed to the intemperate use of alcohol, and doubtless this is one of the causes of the disease; but there are

[1] See therefore the article on DISEASES OF THE SKIN.
[2] See the article on ULCERS, vol. i. p. 153. [3] See the article on TUMOURS, vol. i. p. 270.
[4] Billroth, *Clinical Surgery*. Translated by C. T. Dent, p. 86.

many cases, especially in women, in which there is no such association, and the origin of which is often obscure.

The affection is one of adult and declining life, and is often connected with dyspepsia and with uterine disturbance. Alcoholic intemperance is certainly the most potent factor in the production of the hypertrophic variety; but, although the abuse of stimulants is not confined to one sex, this form of the disease is almost entirely limited to old men.

Treatment.—In all cases of acne rosacea the general condition of the sufferer should be considered, and any irregularities of the digestive or uterine system should be corrected, and the needful abstinence enforced. Regular exercise out of doors; careful but not necessarily low diet, and thorough ablution, are to be recommended, together with such tonics, purges, or aids to digestion as may seem necessary.

For local treatment in the early stages, and when the sebaceous follicles are not notably affected, the red spots should be brushed over with a lotion of bichloride of mercury, of a strength of two or three grains to the ounce, or with strong acetic acid. The raised pimples and patches may be touched with acid nitrate of mercury, and the larger tubercles may be opened with a narrow-bladed knife and the contents expressed.

One of the most useful applications is sulphur in the form either of a soap or an ointment. Fifteen grains of the iodide of sulphur to an ounce of cerate is an appropriate form; all ointment should be applied at night and thoroughly washed off in the morning with oatmeal and hot water. Linear scarification followed by stimulating lotions has also been by some recommended. When the stage of warty and pendulous hypertrophy has been reached, the redundant tissue should be excised.

In operating, the growths may either be simply cut off one by one; or an incision may be made in the median line down to the cartilage, and the skin with its outgrowths dissected off on either side. Care must be taken not to cut through the cartilages. During the operation, the surgeon or his assistant should keep a finger in the nostril to serve as a guide. The bleeding which ensues may be readily checked by pressure or by the application of styptics. There is much less danger of erysipelas and other serious results than is commonly supposed. The exposed surface usually heals favourably under cooling and soothing applications. When cicatrisation is complete, it is remarkable how little disfigurement remains. In some rare instances there has been recurrence of the growth after extirpation.

Deformities and Deficiencies.

The nose is liable to various deformities and deficiencies. Some of them are congenital; others result from accident or disease. Some are more or less perfectly remediable by operation; others are best concealed by masks or artificial noses, which are now made and adapted with great skill.

Entire absence of the nose, as a congenital condition, is extremely rare, but some instances are on record. In the case of a female infant under the care of M. Maisonneuve 'the nose was replaced by a plane surface merely pierced by two small holes.'[1]

Such cases are irremediable by surgery. When the nose has been destroyed by accident or disease, much improvement may in some cases be obtained by plastic surgery. The degree of success attainable will depend chiefly upon the amount of bone and cartilage remaining to support the new tissue, and upon the healthiness of the adjacent skin.

When the soft parts only of the nose are wanting, plastic operations may be undertaken with very satisfactory results.[2]

Occlusion and contraction of the nostrils.—These deformities of the nose are sometimes congenital, but much more rarely so than corresponding conditions of the ear, the anus, or the vagina. In some instances the nostrils are more or less completely closed by membrane,[3] in others by firm fibrous tissue, or by simple continuity of in-

[1] *Bulletin de Thérapeutique,* 1855, vol. xlix. p. 559; quoted by Holmes, *On the Surgical Treatment of Children's Diseases,* 2nd ed. p. 128. [2] See the article on Plastic Surgery.

[3] Richerand, *Nosographie chirurgicale,* 4th ed. tome ii. p. 156.

tegument. In other cases again, one ala or both may be adherent to the septum, or even to the upper lip. All these deformities interfere with respiration, and prevent the infant from sucking uninterruptedly. The earlier therefore they are remedied by operation the better. In most instances a simple incision of sufficient extent carefully made through the obstructing membrane is all that is requisite. The opening must be kept patent by strips of lint or a short elastic cannula, until the cut surfaces are completely skinned over. Sometimes it may be desirable to excise a portion of the obstructing tissue. In cases in which there is no indication of the opening of the nostril, the adherent parts must be gradually and cautiously divided until the nasal fossa is reached. If free respiration is not materially interfered with, or if one nostril only is obstructed, the operation may be deferred for a time.

In a case under the care of Mr. T. Smith in the Hospital for Sick Children, the right nostril had been closed from birth. The corresponding ala was flat and unsightly. The child suffered from snuffling and snoring. The adherent surfaces were divided by the knife, and the opening made was maintained during a period of three weeks by means of a portion of gum catheter. A good result was obtained.[1]

Billroth[2] relates a case of atresia of the nostrils 'in a girl three years old, the result of a cicatricial contraction after variola. The cicatrices were cut out and the openings dilated by laminaria tents. India-rubber tubes were passed in, and ultimately the normal width of the nasal cavities was completely restored.' It was doubtful, however, whether recovery was permanent.

Fraenkel[3] mentions three cases of congenital bony closure of the posterior nares —a very rare condition. Of the first of them he says, 'Emmert operated successfully on such a case in a boy seven years old, who had never from his birth been able to breathe through his nose, who was therefore as a nursling reared with great difficulty, and who had, furthermore, often had suffocative attacks during sleep. No air ever came out of his nostrils, but mucus did, as well as a stream of tears when he cried. The closure was occasioned by a bony wall, covered on both sides with mucous membrane.'

In the second case Luschka had the opportunity of examining the parts in a girl who died soon after birth; the closure was proved to be due to a bony plate developed apparently from the palate bones.

In the third case, which was sent to Fraenkel by D. J. Wolff, the posterior aperture of the right nostril only was similarly closed.

II. AFFECTIONS OF THE INTERNAL PARTS.

For the diagnosis of diseases affecting the interior of the nose, its cavities may be explored by various means, some of which are equally applicable for facilitating the necessary treatment.

Much may be learnt by exploration with the finger passed either into the anterior nostrils, or behind the soft palate up to the posterior nares.

This mode of examination may be used with great advantage if the patient is placed under an anæsthetic, when with a little management the greater part of the nostrils can be explored, and the position of a polypus or portion of necrosed bone often exactly determined.

Rhinoscopy.—The cavities of the nostrils may be inspected from the front either by direct or reflected light.

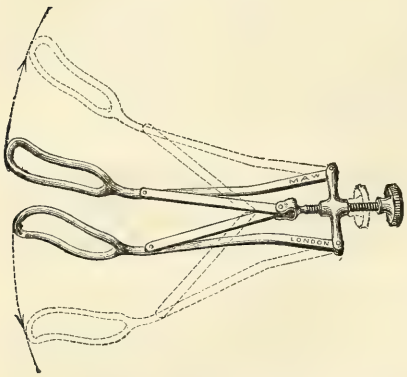
If the patient is placed facing the sunlight, and the tip of the nose is pressed upwards by the thumb, the nostrils will be dilated so as to bring a good deal of their cavity into view. But for more complete examination some kind of speculum is needful, and it is more convenient to reflect the light into the nostril by an appropriate mirror. When sunlight cannot be obtained, an Argand burner with a condensing lens can be substituted, or some of the various forms of the oxyhydrogen or

[1] *Medical Times and Gazette*, March 28, 1863.
[2] Billroth, *Clinical Surgery*. Translated by C. T. Dent, p. 54.
[3] Fraenkel, in Ziemssen's *Cyclopædia of the Practice of Medicine*, vol. iv. p. 113.

the electric light. The reflecting mirror can be fixed to a forehead-band or a spectacle-frame, or it may be held in the hand. The speculum is best made of bent wire, so that it covers as little as possible of the surface to be inspected; and it should be self-retaining, so that the operator has both his hands at liberty.

A very useful form is that known as 'Fraenkel's Nasal Speculum' represented in fig. 140.

Fig. 140.



The blades being introduced, one into each nostril, they are separated by means of the screw which forms the handle of the instrument. The nostrils are thus widely dilated, and the instrument remains in position without extraneous support. It may be used in a similar manner for dilating one nostril only. Another dilator which I have found extremely convenient is that invented by Mr. Cresswell Baber [1] (see figs. 141, 142). It consists of two hooks of silvered wire (curved, as seen in fig. 141) united by an elastic band, passing obliquely round the head, and provided behind with a buckle. Fig. 142 shows the mode of application of the speculum. The double-curved hook passes over the tip of the nose, which it draws upwards; whilst the other hook is inserted into the outer angle of the nasal aperture. The amount of dilatation can be regulated by tightening or loosening the elastic band by means of the buckle behind; and the hooks, being to a certain extent flexible, their curve can be altered to suit individual cases.

Fig. 141.

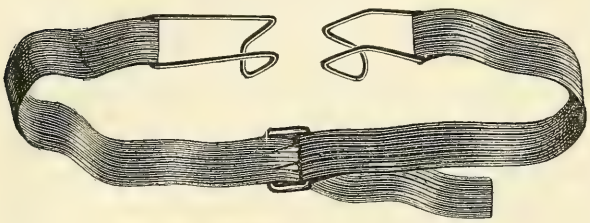


Fig. 142.

In some cases, as suggested by Czermak,[2] a small oval mirror, mounted at an angle upon a long slender stem, may be used with great advantage. When such a mirror is introduced to a greater or less depth through the nostril, and properly illuminated, there may be seen reflected in it various parts which could not otherwise be brought into view.

In order to inspect the nasal cavities from behind, the same general arrangements are necessary as for laryngoscopy. The patient is seated with his back to the light, his head is thrown well back, and his mouth opened as wide as possible in such a

[1] See *Brit. Med. Journal*, Jan. 8, 1881.

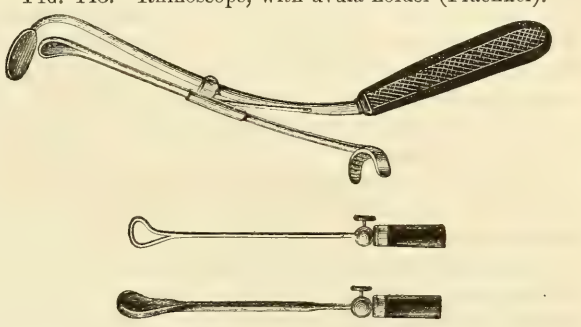
[2] Czermak on the Laryngoscope (*Sydenham Soc. Transactions*), p. 33.

manner as to display the pharyngeal cavity to the fullest practicable extent. For this purpose the velum should be at rest and the tongue lie passively just within the lower teeth.

The surgeon, seated opposite, reflects the light from a frontal mirror in such a direction as to illuminate the pharynx; then, with a spatula held in the left hand he depresses the tongue, and with the right hand introduces the rhinoscopic mirror into the space between the posterior wall of the pharynx and the velum; by slight movements of the mirror reflections of various parts of the nares and pharynx will thus be obtained. The handles of the tongue-spatula and of the rhinoscopic mirror should be so bent that they do not interfere with the light when in use (see fig. 143). The smallest of the laryngoscopic mirrors, with the stem bent into a double curve, answers the purpose very well.

Under favourable circumstances the two superior meatuses may be inspected, and considerable portions of the mucous membrane covering the turbinated bones and the septum may be seen, the posterior surface of the velum can be examined, and if the mirror is turned towards one side, the lateral wall of the naso-pharyngeal cavity and the orifice of the Eustachian tube may be brought into view. But the difficulties of posterior rhinoscopy are great, and it is rarely that the cavities may be inspected to the extent indicated; although this is theoretically possible in most cases, and has been actually accomplished in many. Nevertheless, persevering attempts should always be made in doubtful cases. Experience has amply proved that this method of examination, even when incompletely carried out, may afford most valuable aid, not only in the diagnosis, but also in the treatment of various affections of the nasal cavities. To insure success, considerable practice on the part of the surgeon, and oftentimes great patience and self-control on the part of the patient, are requisite.

Fig. 143.—Rhinoscope, with uvula-holder (Fraenkel).



The principal difficulties are due to the size or want of control of the tongue, to the sensitiveness of the soft palate, and to the tendency of the velum to become raised, stretched, and approximated closely to the posterior wall of the pharynx.

The tongue is best controlled by firm and even pressure by a spatula laid flat upon it and held steadily in one position; sometimes this is best done by the patient himself. The sensitiveness of the palate may be to some extent diminished by sucking ice immediately before the examination; and the retraction of the soft palate may be overcome in many cases by practice on the part of the patient in breathing through the nose as though snoring.

It is far better, if possible, to avoid the use of hooks or other instruments for drawing forward the velum; but occasionally the examination cannot be accomplished without such aid; when this is the case the velum may be lifted and drawn forward by a blunt hook, a thread noose, or by a little moveable spatula fixed to the handle of the rhinoscope (see fig. 143).

Nasal Calculi. Rhinolithes.

Calculous concretions are sometimes formed in the nasal cavities. Instances are rare, but a considerable number have been placed on record.

Cloquet[1] relates several examples, and others are quoted or referred to by Demarquay in his elaborate memoir on the subject.[2] Cæsar Hawkins[3] mentions a case in which

[1] Cloquet, *Osphrésiologie*, p. 627. [2] *Archives générales de Médecine*, 4e série, vol. viii. p. 174.
[3] Cæsar Hawkins, *Contributions to Pathology and Surgery*, vol. i. p. 225.

concretions, exactly the shape of the superior spongy bone, used to come away from time to time either by the nostril or from the throat of a delicate person subject to hæmoptysis. The same author alludes also to an instance in which both nostrils were obstructed by chalky bodies, which, with the accompanying inflammation and swelling, produced an appearance resembling that of a malignant polypus.

These concretions are, for the most part, met with in the inferior meatus, and the majority are formed around some foreign body which has been retained in the nose. Sometimes, however, the nucleus appears to be simply inspissated mucus.

These calculi consist (according to the analyses of Bouchardat) of the phosphates and carbonates of lime and magnesia, chloride of sodium, and mucus or some other animal matter.

The ordinary symptoms of the presence of a foreign body or calculus are dryness of the affected nostril, accompanied by a sense of weight and fulness; frequently more or less obstruction of respiration; pain of an intermittent neuralgic character referred to the nose or forehead; and sometimes inflammation, and swelling of the adjacent parts, with copious discharge of mucus and pus from the nares. The sense of smell may be impaired or abolished. The eye may suffer discomfort also from the obstruction of the nasal duct.

Sometimes it will be possible to obtain a history of the introduction of some foreign body into the nostril, a not uncommon occurrence with children. The diagnosis can usually be made certain by the use of a probe or by rhinoscopic inspection; but it must be remembered that the mucous membrane of the nose has been known to undergo calcareous degeneration, a condition which might be mistaken for a calculous formation.

Treatment.—The treatment will consist in removing the concretion or foreign body, and thoroughly washing out the cavities by means of the nasal douche. It is of course important to ascertain certainly the presence and situation of the body to be removed, and it may not be out of place to point out that a thorough examination of the nose should be made before any such operation is attempted; for in children, though there may be a clear history of the introduction of a foreign body, it may have fallen out or have been swallowed without the knowledge of the patient; and it has happened to myself to find and extract a foreign body from the *right* nostril, when the mother of the child (an intelligent person) insisted positively that it was in the *left*.

The patient should be placed as for anterior rhinoscopy, and a good light reflected into the nose from a frontal mirror. The most convenient instruments to use are thin-bladed dressing-forceps and small scoops. But care is requisite in seizing the calculus, otherwise the pressure of the instrument may only serve to push it more deeply into the cavity. Forceps made in two distinct portions, which can be introduced separately and afterwards locked together, are very useful for the purpose. After the extraction of a foreign body, all that is usually needful is the washing out of any secretion which collects in the nose with a soothing lotion.

When there is a tendency to the formation of calculi, it will probably be found that there is some constitutional disease requiring correction. In one case related by Mr. Cæsar Hawkins much benefit was derived from the administration of arsenic and sarsaparilla. Graefe considers that the gouty dyscrasia favours the production of nasal calculi; any symptoms of this disease therefore, or of syphilis or scrofula, should meet with appropriate general treatment. The local applications to be used after the removal of the calculus should be such as are adapted to cleansing the nasal cavities, and correcting any unhealthy condition of the lining membrane; weak alkaline solutions, diluted glycerine, and solution of permanganate of potash, are among the most useful.

Epistaxis. Bleeding from the Nose.

The mucous membrane of the nose is very vascular: its blood-vessels are numerous, though none of them are very large; they are derived from many different sources, and they anastomose very freely; they form, especially in the young, impor-

tant media of communication between the vessels within the cranium and those which are distributed externally; the tissues which support them are in close relation with bone or cartilage, and are subject to injuries, abrasions, and ulcerations; and the vessels themselves are liable to become distended and congested from various different causes. Hence it happens that bleeding from the nose is of very frequent occurrence. In a large proportion of cases such bleeding is of trifling importance. In some cases it seems to afford relief, and to be really beneficial. Sometimes, however, it is symptomatic of visceral disease, or of degeneration of blood. Occasionally, if unchecked, or if frequently recurrent, it may prove serious, dangerous, or even fatal. The blood usually escapes from the nose drop by drop, but sometimes it flows in a fine stream. As a rule it comes from one nostril only, rarely from both simultaneously.

Epistaxis may be 'accidental' or 'spontaneous' in origin.

Accidental epistaxis resulting from a blow upon the nose, with or without fracture of the bones, is very common. In some boys it may be brought on by a very slight blow, or by any unusual exertion, or even by sneezing, or blowing the nose violently. It rarely goes on to a serious extent.

Spontaneous epistaxis arises from many different causes. It may occur as capillary hæmorrhage consequent upon either active or passive congestion; or it may result from ulceration extending into some one or other of the larger vessels, or it may be associated with, and indicative of, the presence of a polypoid growth.

The spontaneous epistaxis so frequently met with among young people of nervous temperament and delicate skin, is one of the most common forms of capillary hæmorrhage. It is usually preceded by active congestion, which is sometimes associated with over-fulness of the intracranial vessels, and accompanied by flushing of the face, buzzing in the ears, and a sense of heaviness or even severe headache. These symptoms are commonly relieved by the bleeding.

In young women capillary hæmorrhage from the nose is occasionally vicarious of suppressed menstrual flow, and under such circumstances may be considered salutary.

Bleeding from the nose frequently occurs in scurvy, and fever, and in other affections associated with an impoverished state of the blood. In persons of hæmorrhagic diathesis it often becomes a source of great anxiety and difficulty.

The epistaxis of declining or advanced life should never be lightly regarded. It is usually preceded by mechanical or passive congestion, which may result from over-distension or obstruction of the vessels conveying the blood from the brain, or may betoken the existence of some visceral disease of more or less serious character. The blood that flows is often venous in appearance.

Treatment.—In the treatment of epistaxis discrimination and judgment on the part of the surgeon are demanded as frequently as promptitude and skill. It is one thing to devise and apply the best means for the immediate arrest of the hæmorrhage; it is another to decide whether or not it is better to make the attempt. In very many cases the conditions which have given rise to the bleeding require treatment, rather than the incidental and temporary flow of blood which indicates the existence of such conditions. In some instances the non-recurrence of periodical or habitual epistaxis may betoken the approach of danger; and in others the sudden arrest of the bleeding by surgical interference may be followed by symptoms of the gravest import.

Accidental epistaxis may usually be arrested by the simplest means. So also, as a general rule, may the spontaneous capillary epistaxis of early life. Cold applications to the nose and forehead, snuffing cold water up the nose, the introduction of a piece of ice into the nostril, and such-like remedies are generally efficacious. The nursery remedy of slipping a cold key down the back, or far better of suddenly dashing cold water over the spine, seems sometimes to answer almost magically;—possibly, as has been suggested, through some reflex action excited in the vaso-motor nervous system. In some cases the vertical elevation of the arms as high as possible above the head is successful.

Another simple and often effectual method consists in firmly compressing the ala of the affected side against the septum, and pressure may sometimes be made upon

the bleeding point by a finger introduced into the nostril. The patient should be kept quiet and cool; and should sit upright with the head very slightly inclined forwards, so that if there be any bleeding the blood may find its way out of the anterior nostrils and not into the pharynx.

If these means are insufficient for the arrest of the bleeding, a stream of iced water or of some astringent solution should be passed through the nostril by the nasal douche. Or astringents, such as the solution of perchloride of iron, may be applied to the interior of the nostril by a pair of curved forceps, around the blades of which is wrapped a piece of lint saturated with the astringent.

On the failure of such measures as have been described there remains the expedient of plugging the anterior and posterior nares. This, though unpleasant to the patient, and not always easy to the surgeon, is so certainly efficacious, that it should never be delayed when the loss of blood has been dangerous. The best apparatus for this purpose with which I am acquainted is the inflating nasal plug invented by Mr. H. C. Howard. 'It consists of an india-rubber bag of the length of the nostril, compressed in the middle, so that the two enlarged ends plug respectively the anterior and posterior nares. The narrowing in the middle is made for the purpose of allowing the pressure to be as little as possible on the inferior turbinated bone. It is passed into the nose by a probe hitched on the under side. To the anterior extremity is attached a tube with stopcock, by which the plug is inflated.'[1] To remove the plug it is only necessary to allow the air to escape by turning the stopcock, when by pulling on the tube it is easily withdrawn. The advantages of this instrument are its easy introduction and withdrawal, and its cleanliness.

The operation of plugging the nares may also be accomplished by means of Belloc's sound. This consists of a silver cannula (slightly curved at the distal end, and six or eight inches in length), within which freely slides a stylet some four or five inches longer than the cannula. The proximal portion of the stylet is rigid to an extent corresponding in length to the straight portion of the cannula. Its distal portion is made of a piece of 'mainspring' which tends to curve round in the proper direction, and is terminated by a perforated button. The operation is performed as follows:—The eye of the button is threaded with a long piece of strong silk, and the stylet is drawn up until the button lies against the end of the cannula. The instrument thus armed is passed along the floor of the nose into the pharynx. The stylet is then pushed along the cannula, and the spring turns round the posterior border of the velum into the mouth. The silk is seized and drawn out through the mouth, and a portion of sponge of sufficient size to fill the naso-pharyngeal opening somewhat tightly is attached to it. The instrument is next withdrawn, carrying with it through the nostril the other end of the silk. By means of traction upon the silk and manipulation with the finger, the piece of sponge is then fitted into the naso-pharyngeal opening in such a manner as to block it up completely. Lastly, a second plug of lint or sponge is attached to the other end of the silk, and firmly fitted into the nostril. It is obvious that this operation may be accomplished as effectually, though perhaps not so easily, by various other instruments, as, for example, a long bent probe, the stripped feather portion of a quill, or a gum-elastic catheter. The last-named instrument, properly threaded throughout its length and carrying a loop of silk hanging through its eye, answers extremely well. The plugs should not be allowed to remain more than about forty-eight hours, for they are necessarily a source of discomfort and irritation, and are liable to give rise to the formation of matter, which may speedily become offensive, and possibly poison the system. Professor Gross[1] says: 'I have seen several cases where from this cause the patient lost his life, being seized with a low form of fever, attended with delirium, which nothing could arrest. In one of the cases there were marked symptoms of pyæmia.' The plugs may be easily removed by cutting the silk which connects them, withdrawing the anterior plug from the nostril, and pushing the posterior one into the pharynx, where it is caught by a spoon or a pair of forceps; or

[1] See *Brit. Med. Journ.* Dec. 3, 1881, p. 896.

by means of one end of the silk, which may have been left to hang through the mouth. After the removal of the plugs, the cavity of the nose should be gently washed out.

Coryza.

The term coryza designates a symptom rather than a disease. It implies an excessive discharge of altered mucus from the nose. The discharge may be watery and clear, or glairy and thick, or even muco-purulent. It may depend upon catarrhal, strumous, syphilitic, or other affections of the mucous membrane; upon the inhalation of irritants, such as ordinary dust, the pollen of plants, or the other common atmospheric impurities; or upon the presence of a new growth, such as a polypus. If the discharge is free from fœtor, the term 'coryza' is used for this symptom, but if it be accompanied by an offensive odour, the name 'ozæna' is given to it.

The most common cause of *acute coryza* is catarrhal inflammation of the pituitary mucous membrane, or, to use the popular designation, 'a cold in the head.'

This is usually due to sudden atmospheric changes, and especially to exposure to cold or wet, but may also arise from contagion from a person so suffering. It is accompanied by a variable amount of febrile disturbance, and by a sense of fulness and weight about the brow. The nasal membrane is at first dry, and sneezing is frequent; swelling and redness soon supervene, together with increased secretion, which is at first watery, then thick and tenacious, and finally often muco-purulent in character. The discharge is often somewhat acrid and irritates the lip, and there may be at the same time an attack of labial herpes.

After a variable time the symptoms usually subside without any treatment, and the malady is not thought by most persons to be worthy of any special attention. It must be remembered, however, that nasal catarrh is one of the early symptoms of some of the specific fevers, such as measles and diphtheria; and also that an extreme liability to this affection on very slight provocation is often one of the manifestations of a scrofulous or otherwise delicate constitution.

In its earliest stage a 'cold' may sometimes be cut short by a thorough sweating, as by a Turkish bath. Some persons also find benefit from a dose of opium, and from frequent and small doses of quinine. If the secretion is extreme, or painfully irritating, the nose may be washed out with a solution of chlorate of potash (5 gr. to ʒj.)

Persons with a very sensitive nasal membrane may with advantage paint the interior of the nose with glycerine before exposing themselves to a cold or impure air.

The *chronic form of coryza* depends either upon the presence of a foreign body or a new growth, or upon certain constitutional conditions.

The first two causes are considered in other parts of this article; it remains to point out the constitutional diseases giving rise to this symptom.

In the infant, inherited syphilis is the most common cause of chronic coryza. It is one of the earliest, and may be for a time the only symptom of the disease, though it is usually succeeded by other manifestations, such as the characteristic eruptions, which aid the diagnosis. The obstruction to the nostrils and the resulting difficulty of breathing and sucking, are often serious embarrassments to the child; and are so marked a feature of the disease as to have given to it the popular name of 'the snuffles.'

In older children the affection is more frequently associated with the scrofulous diathesis, of which chronic inflammation of the skin and mucous membrane is so prominent a symptom. Children thus affected are at the same time subject to ophthalmia, to eczematous eruptions upon the skin, and to enlargement of the lymphatic glands. In many, however, the nasal catarrh is the chief or most obvious symptom, and, like other scrofulous inflammations, is apt to be of great pertinacity. It is in these cases especially that the pituitary membrane, especially that part which covers the inferior turbinated bones, undergoes chronic thickening, a condition which gives rise to troublesome obstruction of the nostrils. This obstruction, and the appearance of the hypertrophied membrane projecting unduly across the nostril,

have led sometimes to the disease being mistaken for polypus; from which it is to be distinguished by its comparative immobility, so that it cannot be brought lower down by blowing the nose; by the absence of pedicle; by its red and velvety surface; and by the fact that obstruction is seldom so complete as in cases of polypus. It is necessary, however, to bear in mind that this condition may be, and often is, associated with the growth of polypi, which it may partially conceal from view.

In adults, chronic coryza depends generally either upon syphilis, or upon an eczematous state of the nasal membrane, chiefly of gouty origin. But in some cases no constitutional tendency can be discovered to account for it.

Syphilitic coryza is commonly met with among the later and more persistent secondary symptoms; but it is very apt to recur from time to time in cases not thoroughly treated, so that it is frequently seen in persons apparently otherwise healthy, long after the original infection. The discharge is variable both in quantity and quality, but is always thicker than natural, usually slightly purulent, and occasionally streaked with blood. On examination the membrane presents thickened and vascular patches, and superficial erosions often coated with an albuminous-looking white film. In the syphilitic affection the changes in the membrane are less general and uniform, and more in scattered patches, than in the other forms of chronic coryza, and the diagnosis may be assisted by the history, or other evidences of past or present disease. The discharge which occurs in connection with the tertiary affections of the bones of the nose is almost always offensive, and would therefore bring such cases into the class of ozæna.

In persons of gouty constitution, and especially in those who suffer from eczema, a troublesome coryza is met with, which depends upon an eczematous eruption upon the nasal lining membrane. In these cases there is a general increase of vascularity, and some slight swelling of the membrane, and a good deal of thin watery discharge. The affection is not uncommonly confined to one nostril.

Treatment.—In the treatment of chronic coryza it is of great importance to discover, if possible, the constitutional condition upon which the malady depends.

Infants suffering from inherited syphilis, and in whom the coryza is severe, will require constant local treatment, in addition to the administration of mercury. The nostrils must be kept clear by gentle syringing with weak solutions of permanganate or chlorate of potash, and an ointment of oxide of zinc diluted with oil may be applied by a brush to the nostril and upper lip with great advantage. These cases soon repay attention, for it is remarkable how rapidly these miserable infants improve when properly treated with mercury, aided by such local measures as enable them to suck more easily.

For scrofulous coryza similar local treatment, combined with sunlight, fresh air, and the administration of cod-liver oil, will be found desirable. Chlorate of potash and small doses of iodide of potassium, given in steel wine, are remedies of great value; and a very useful local application is an ointment of ten grains of the red oxide of mercury to half an ounce of olive oil and the same quantity of lard, which must be deposited in the nostril by a soft brush, the ala being squeezed against the septum as the brush is withdrawn. Solutions of borax or tannin in glycerine may be used in the same manner, and if the child is old enough, he must be taught to use the nasal douche.

For the syphilitic coryza of adults the constitutional treatment is of the first importance. Mercury in some form is almost always necessary; the biniodide has seemed to me an especially useful preparation. Local treatment is not of much use, unless the discharge is sufficient to require the nasal douche.

The coryza occurring in gouty persons will be found to be greatly influenced by diet, so that abstinence from those foods which are provocative of gout should be enjoined, and attention should be paid to the state of the digestion. The administration of arsenic in combination with alkalis will almost always be found beneficial; and much improvement is often obtained from judicious purgation. The glycerine of starch is a useful local application.

Cases are occasionally met with in which, with more or less swelling of the naso-

pharyngeal and naso-palatine mucous membrane, there is a peculiar enlargement of the glandular structures belonging to it.

According to Dr. Andrew Clark [1] the racemose and compound follicular glands are especially affected. These glands are most numerous about the posterior nares, round the opening of the Eustachian tubes, and in the roof of the pharynx. Under the influence of this chronic irritation an excessive quantity of viscid mucus is secreted. At a later period pus-like fluid may be discharged. Still later the mucous or purulent secretion, if retained for some time, may become converted 'into little fœtid cheesy masses, which are from time to time extruded through the nose or mouth.' Accompanying these conditions the mucous membrane generally is more or less irregularly swollen. The ordinary symptoms are, 'discomfort, aching, or pain in the neighbourhood of the soft palate and posterior nares; tingling or sense of fulness about the root of the nose; frontal headache: a thick mucous, purulent, or cheesy secretion discharged at intervals, chiefly through the mouth, by means of snorting nasal inspirations, followed by hawking; slight perversions of taste and smell; alterations of voice; sometimes temporary deafness from obstruction of one or both Eustachian tubes, and an abundant secretion of wax in the external ear.' [2]

The treatment is tedious and often unsatisfactory. Mild astringents are to be used with the nasal douche, and attention should be directed to the general health, especially to the condition of the digestive organs, which are frequently disordered in these cases. Purgatives, followed by tonics, are generally indicated, and sometimes cod-liver oil and steel.

In another group of cases, especially described by Dr. Wilhelm Meyer of Copenhagen,[3] exuberant growths or vegetations are met with in certain parts of the naso-pharyngeal cavity. These vegetations, when examined microscopically, are found to consist of the so-called 'adenoid tissue,' and are accordingly to be regarded as overgrowths or morbid growths of the closed glandular structures found in or beneath the mucous membrane of the pharynx, the fauces, and the base of the tongue. They vary in form and consistency: sometimes they are solid and firm, and at others soft and highly vascular, and prone to bleed.

The presence of these vegetations in any considerable quantity impedes respiration through the nose, and gives a peculiar 'nasal' character to the voice. There is often some degree of deafness. 'The nostrils are flattened so that the nose appears compressed.' There is deficient secretion from the nostrils, and sometimes blood accumulates in the mouth. Digital examination and rhinoscopic inspection demonstrate the presence of the outgrowths. They are most frequently met with in underfed young people. The treatment consists in removing the vegetations by the knife, or by the galvanic cautery, or by repeated applications of nitrate of silver. Dr. Meyer recommends the use of 'a ring-shaped knife, mounted on a long slender handle, which is passed through one or other nostril, and manœuvred so as to sweep over the mucous surface affected. The bleeding is free but not excessive.' Two or more operations are sometimes necessary. According to Dr. Meyer, the results of this proceeding, supplemented by the use of the nasal douche, have proved very satisfactory.

A copious discharge of watery fluid from the nose has been known to occur in connection with the polypi of the antrum. Sir James Paget has related [4] the case of a lady 49 years old, from whose left nostril watery fluid was constantly dropping for eighteen months. She was a healthy-looking person, in whom no signs of ill-health or any appearance of disease in or near the nostril could be found. 'There was nothing like polypus, or unhealthy membrane or swelling as of a cyst; no nasal obstruction or unusual flow of tears; no swelling or tenderness; nothing whatever to indicate the source of the fluid.' Six months before the fluid began to flow, the patient had had a blow on the left frontal sinus; besides which she had undergone a great deal of mental distress.

[1] Dr. Andrew Clark, 'On Naso-palatine Gland Disease,' *London Hospital Reports*, vol. i. p. 211.

[2] Dr. A. Clark, *op. cit.*

[3] *Proceedings of the Royal Med.-Chir. Soc.*, October 18, 1869. 'On Adenoid Vegetations in the Naso-pharyngeal Cavity,' by Wilhelm Meyer, M.D., of Copenhagen, Communicated by John Marshall, F.R.S.

[4] *Clinical Soc. Trans.* vol. xii. p. 43.

It flowed in nearly uniform quantity, a drop running down on the lip every five or six seconds, but was increased by mental distress or physical exertion. None ever came from the right nostril, 'unless when the left nostril and upper part of the pharynx had become filled with fluid during sleep at night; and then, on turning the head downwards and to the right, the fluid poured through both nostrils.'

The fluid looked like pure water; its specific gravity was 1004, it was slightly alkaline, and in 100 parts of the liquid there was 1·15 of solid matter in solution, chiefly chloride of sodium.

Sir James Paget refers to a case of Sir Benjamin Brodie's, in which a lady was twice subject to the dropping of a similar fluid from one nostril. 'First, when she was 26, it began almost suddenly, and so ended after thirteen months. Then, when she was 40, it began slowly, and so ended after twenty-three months. The quantity of fluid discharged was greater than in the case above related; it seems to have been usually two quarts, and once was three quarts in the day.' There was no indication of its source. After the use of sulphate of zinc, locally and internally, the flow ceased. Sir J. Paget advised the same treatment. The patient took a grain of sulphate of zinc, afterwards increased to two grains, three times a day; and injected into the nostril three times a day a solution of sulphate of zinc, three grains to the ounce of water. 'This plan was steadily followed for about six weeks: then the dropping of the fluid gradually diminished, and in two or three weeks more completely ceased.

A month subsequently, after exposure to mental distress, fatigue and cold, she was attacked with meningitis and died. In the left antrum were found polypoid growths of very fine filamentous tissue infiltrated with serum, and there were signs of chronic catarrh of the lining membrane of the cavity. All the other nasal cavities and sinuses were healthy.

Mr. Dalby has kindly given me the particulars of another case in which this curious symptom was met with. A lady, aged about 30, had a profuse discharge of watery fluid from the left nostril. This occurred first in 1878, when it lasted night and day continuously for ten days, and then suddenly ceased. In 1881 it recurred without apparent cause, and after it had lasted seven weeks she consulted Mr. Dalby. On arriving at his house, the dropping of the fluid suddenly stopped, but after the patient had been engaged in conversation for a short time, and her attention had thus been diverted, the fluid again began to run from the nostril. Mr. Dalby could find no disease of the nose or adjacent sinuses. After lasting three months the dropping of the fluid ceased, not apparently from any treatment, though some weak alkaline injections had been used.

Ozæna.

Among the diseases affecting the nasal cavities, there is none more troublesome, both to the sufferer and to the surgeon, than ozæna. The essential characteristics of this disease are an offensive discharge from the nostrils, and a peculiar and disgusting fœtor of the breath. The latter is sufficient to contaminate the air of the room which the patient occupies, and to debar him from society, and sometimes even from employment; moreover the patient himself is constantly conscious of a most offensive odour. For these reasons the disease is peculiarly distressing, and often affects the health and happiness of the sufferer to an extent quite out of proportion to its inherent gravity. The treatment of the affection requires much patience and perseverance, and its success will depend, as in other diseases, very much upon the correct ascertainment of the cause of the malady.

Ozæna arises from various causes, and is associated with many different conditions; most of the cases, however, may be placed in one of the following three groups: 1. scrofulous ozæna; 2. syphilitic ozæna; 3. traumatic ozæna. But it must be admitted that cases are sometimes met with, which cannot be distinctly referred to either of the causes indicated by the names given above, and of which the origin is not easily discoverable. These, for the want of a better name, may be called cases of 'idiopathic ozæna.'

First of all, it will be convenient to describe the symptoms common to all the

varieties of ozæna. They are chiefly these: (*a*) A constant discharge of diseased secretion from one or both nostrils. This discharge is usually a thin muco-purulent fluid, mixed with epithelium, and occasionally streaked with blood. Sometimes it consists chiefly of a gelatinous material, with little or no pus in it; or it may resemble thin gruel. Much of this discharge finds its way through the posterior nares into the pharynx; it also, of course, escapes by the anterior nares. The discharge, of whatever kind, is very offensive, and the breath has an indescribable and most disgusting fœtor. (*b*) The sense of smell is either abolished or materially interfered with, and the patient is conscious of a fœtid odour. (*c*) There is usually some tenderness of the nasal walls, and often frontal headache.

The most common cause of ozæna is *scrofula*; and as scrofula is a disease of childhood, we find, as might be expected, a large number of the cases of ozæna occurring in children and young persons. It must not, however, be supposed that all the cases of ozæna seen in children are of a scrofulous nature, though the majority of them are so. A considerable number of them have their origin in syphilis.

The scrofulous cases usually show other signs of the diathesis, but in addition to the symptoms described in connection with scrofulous coryza, an examination of the nose often reveals a number of small pustules and ulcers dotted over the surface of the swollen mucous membrane. Upon these ulcers crusts form, which, with the swollen membrane, tend to block up the nostrils, and to retain the secretion in the sinuses. It is probably to the retention and decomposition of this secretion that the fœtor in many cases of ozæna is due; it can therefore be to a great extent overcome by the frequent cleansing of the nasal cavities by antiseptic solutions. But there are other cases, those in which the fœtor is most horrible, in which such treatment does no more than somewhat lessen the odour, and has no curative effect upon the disease. Such cases I believe to be due to the presence of dead bone, and to be curable only by its removal.

In many of the cases of scrofulous ozæna there is not only ulceration of the mucous membrane, but also necrosis of the bones of the nose—a fact which is not surprising when we remember how often, in other parts of the body, scrofula gives rise to bone-disease.

Next to scrofula, *syphilis* is the disease which most commonly gives rise to ozæna. The affection commences either as a tertiary ulceration, or as a gummatous periostitis. The ulceration often occurs chiefly at the back of the nostrils, and is seen best by posterior rhinoscopy. The ulcers are in some cases quite superficial, and coated with the peculiar albuminoid film often seen on those of the throat and tongue. In others the ulcers are deep, and have excavated edges, and are covered with sloughs. In all, the ulcers are irregular in shape, often running one into the other, and having a tendency to spread in one direction while healing in another. There is less swelling of the mucous membrane than in scrofulous ozæna; and the ulcers in syphilis are larger, less numerous, and more irregular in shape. After a time the bones become diseased; and these are amongst the most offensive cases of ozæna. Or the bone disease may be secondary to gummatous periostitis, which often leads to extensive necrosis. The affection occurs both in acquired and in inherited syphilis, and is usually accompanied with other syphilitic symptoms.

Traumatic ozæna may arise either from a blow upon the nose, giving rise to periostitis and subsequent necrosis of the bone, or may be the result of the introduction of a foreign body into the nostril.

As might be expected, the cases arising from a blow usually (probably always) are connected with the presence of necrosed bone. They are therefore favourable for operative treatment, and may be subjected to it at an earlier period than the other varietes of ozæna. There is but slight swelling of the mucous membrane, and no ulceration except at the situation of the dead bone, which is often beyond the area of sight or touch.

Ozæna arising from the presence of a foreign body is seen sometimes in children, who have been known to thrust a variety of substances into the nostrils—such as peas, beans, beads, pieces of pencil, wool, &c. It is well to bear in mind the possibility

of such a cause for cases of ozæna occurring in children with no evidences of constitutional disease. A foreign body may give rise either to ulceration of the mucous membrane alone, with offensive discharge, or there may be caries of the bone also. If there is no bone-disease, the removal of the offending substance soon produces a cure, as the fœtor of the discharge is in great part caused by its being pent up in the nose, from the difficulty of exit produced by the presence of the foreign body and the accompanying swelling.

Besides these there are cases of ozæna which cannot be placed in either of the above-named groups, and which it is convenient to class together under the name of *idiopathic ozæna*. They are seen sometimes in perfectly healthy people, in whom no cause can be discovered: but a good many occur in children who have recently had one of the acute specific diseases, *e.g.* scarlatina or measles; and I have seen several in young women with disordered menstruation. This form of the disease appears to me to be much more common in women than in men. In such cases there is usually only slight swelling of the nasal mucous membrane, which, however, is of a bright red colour, with here and there velvety raised patches, which easily bleed. There are often no visible ulcers, and I think in the less offensive examples, no disease of the bone. Yet doubtless in some the bones become affected, and it is upon the presence or absence of bone-disease that the possibility of curing the patient without operation depends.

It ought to be mentioned that in some cases of ozæna the frontal sinuses are involved in the disease, and large quantities of purulent fluid collect in these cavities, giving rise to intense pain and distress. A prominent symptom in these persons is sleeplessness, as has been pointed out by Mr. Cæsar Hawkins. I have seen very great distress caused by this sleeplessness, and the frequent nightmare which occurs when sleep is obtained. The pain and sleeplessness gradually increase as the sinuses become more distended, and there is often some œdema of the upper eyelid and brow. A copious discharge then takes place through the nostrils, and the patient is for a time relieved. Of course if the discharge does not occur, the sinus may become so much distended as to cause displacement of the eyeball; or the matter may make its way externally or even into the cranium. Usually, however, there is a periodical collection and discharge of the secretion, in the manner I have described.

The *treatment* of ozæna must of course depend in each case upon the cause of the disease, and the particular variety with which we have to deal; and I need hardly say that our first step should be a thorough examination, both of the constitutional condition of the patient, and of the part concerned in the disease.

It will be well to have the nose thoroughly cleansed by the nasal douche before making the rhinoscopic examination. The method of washing out the cavities of the nose is a practical application of a physiological fact discovered by Professor Weber of Halle; viz., that when one side of the nasal cavity is entirely filled through one nostril with fluid by hydrostatic pressure, while the patient is breathing through the mouth, the soft palate completely closes the choanæ, and does not permit any fluid to pass into the pharynx, while the fluid easily passes into the other cavity, mostly round and over the posterior edge of the septum narium, and escapes from the other open nostril, after having touched every part of the first half of the cavity of the nose, and a great part—certainly the lower and median canals—of the second half.[1]

The apparatus required consists of a yard of elastic tubing to one end of which is attached a perforated india-rubber nozzle to fit the nostril; to the other end of the tube is fitted an india-rubber bag or glass vessel for holding the fluid to be used: or it may be connected with a piece of metal tube bent as a syphon, or terminated by a small metal funnel which is sunk in a jug containing the liquid.

The method of using the nasal douche is illustrated by fig. 144. The receptacle is filled with the liquid to be used, and placed on a level somewhat above that of the head of the patient. The precise height may be varied according to the degree of force with which it is desired that the stream should flow.

The tube is either filled by the simple descent of the fluid, or, if the syphon action

[1] Thudichum, *On Polypus in the Nose and Ozæna*, p. 17. (Churchill, 1869.)

is adopted, by pouring a sufficient quantity of fluid into it, and then immersing the footpiece in the jug, &c., or by drawing fluid into the tube after the footpiece has been immersed.

The nozzle is then held in the nostril, the patient being seated with his head slightly inclined over a basin, and breathing only through his mouth. In this way a gentle stream of fluid is passed in at one nostril, round the posterior border of the septum, and out at the other nostril. The force of the stream will be in proportion to the height at which the receptacle is placed, and should not be greater than is just sufficient to carry the liquid through.

FIG. 144.—Method of using the Nasal Douche.

This is the most efficient plan, not only of cleansing the nasal cavities, but also of applying medicated solutions to them. It is desirable to use some fluid of higher specific gravity than water; and for simply washing out the nose a solution of common salt, a teaspoonful to a pint of water, answers very well.

In the treatment of *scrofulous ozæna*, the constitutional remedies will be more important than the local. The patient should, if possible, reside at the seaside, and be placed under the most favourable hygienic conditions; and cod-liver oil and iodide of iron[1] should be given regularly for long periods. The digestive organs should be carefully attended to, and the food properly selected. The local treatment chiefly consists of the frequent washing out of the nasal cavities with saline solutions, such as that of common salt or of phosphate or carbonate of soda. Another solution that I have found useful is one of chlorate of potash and tincture of myrrh, two drachms of each to a pint of water; or permanganate of potash may be used, in the proportion of two drachms of Condy's fluid to a pint of water. But whatever may be selected, frequent changes will be found beneficial. If after a long perseverance with this treatment there is no improvement, the nasal cavities should be carefully explored during anæsthesia, as in all probability diseased bone will be found. Dr. Rouge of Lausanne, in a most interesting paper upon the subject,[2] has published eight cases of long-standing ozæna, in all of which he has found and removed dead bone from the cavities of the nose. Dr. Rouge has moreover invented an ingenious operation for the purpose of obtaining free access to the nasal cavities, which enables the surgeon to discover and remove with ease any dead bone therefrom.

The operation consists of separating the soft parts of the nose from their bony framework, by incisions through the mucous membrane where it is reflected from the upper lip on to the gums. The lip and nasal cartilages are then lifted completely up towards the forehead, when the nasal sinuses can be explored with the greatest facility. The parts being replaced, no deformity whatever results, nor is there any visible scar. The operation is, I think, a very valuable one, and will be found applicable to other conditions besides that for which Dr. Rouge has used it. I shall subsequently refer to an instance in which I removed polypi by this method. Of Dr. Rouge's eight patients, all were cured except one, in whom, after a second operation in which a considerable portion of the ethmoid bone was removed, death occurred from meningitis.

[1] The best mode of giving this medicine is, I think, by dissolving iodide of potassium in steel-wine. I believe the syrup of the iodide of iron to be an almost useless preparation.

[2] *Nouvelle Méthode pour le Traitement chirurgical de l'Ozène*, par le Dr. Rouge, Chirurgien de l'Hôpital Cantonal, à Lausanne, 1873.

I have myself treated four intractable cases of ozæna by this operation, and in each case have discovered necrosed bone. In two cases the operation was completely successful; the dead bone being removed, the discharge ceased without further trouble. But in one case, though the patient was temporarily cured, after eighteen months the discharge recurred, and I presume there was fresh necrosis; and in a fourth instance, though I was able to remove two pieces of necrosed bone, there remained a large exposed surface at the base of the skull. I saw this patient about a year after the operation, when the nostril was still discharging; there was no perceptible ozæna, but the nasal douche was used daily so as to keep the cavities thoroughly clean.

While fully appreciating the ingenuity and value of the operation, I confess that I am not inclined to expect quite such favourable results as Dr. Rouge so fortunately obtained, chiefly because there are a considerable number of cases of ozæna in which there is a carious surface at the base of the skull which cannot be removed, and as long as this remains unhealed the discharge will continue.

Moreover I have found by experience that more free access than would be supposed can be obtained to the nasal cavities by placing the patient under an anæsthetic and pushing the septum on one side, and by this means I have in several cases been able to discover and remove dead bone, the presence of which I could not otherwise ascertain. The nostril having been explored, the displaced septum can be pushed back into its place, and as far as I have seen, no harm results.

Still there will always remain some cases in which no such measure avails, and for these we have a valuable resource in Rouge's operation.

Syphilitic ozæna requires the constitutional treatment of the disease of which it is a manifestation. Mercury must be given, and its influence gently maintained for a considerable period. This is best done by the calomel vapour-bath, or by inunction. If for any reason, however, the medicine cannot be given by the skin, I think the gray powder or the perchloride are the best preparations. Iodide of potassium and freshly-made decoction of sarsaparilla are also useful in combination with the mercurial treatment, and such tonics or other medicines as the general state of the patient may indicate. Infants and young children—the subjects of inherited syphilis—bear mercury given internally better than adults; and for these, either the mercurial belt or the gray powder should be used. Cod-liver oil may often be advantageously given at the same time.

Locally, I think, when the bone is not affected, the best application is an ointment composed of fifteen or twenty grains of the red oxide of mercury with half an ounce of olive-oil and half an ounce of lard. This should be applied with a brush after the nose has been washed with the nasal douche. The ammonio-chloride of mercury ointment, diluted with oil, is also useful. In syphilitic patients operative interference should be deferred until the constitutional treatment has been thoroughly carried out, so that there may be a probability of the bone-disease having come to an end, and a cure resulting from the removal of any sequestrum that may be found.

Ozæna, the result of the presence of a foreign body in the nose, usually requires for its cure only the removal of the offending substance, and the frequent washing out of the nasal cavities by some antiseptic solution, such as that of permanganate of potash or common salt. When there is a distinct history of a blow, operative treatment may be hopefully undertaken after a few months' trial of milder measures; for the discharge probably depends upon the presence of necrosed bone.

For cases of *idiopathic ozæna*, the treatment must be chiefly local; yet it is important to carefully search for, and treat, any disturbance of the health that may exist. The local treatment that has seemed to me most useful consists of the frequent use of a lotion of chlorate of potash and tincture of myrrh. It is well, however, to vary the application, and for this purpose the glycerine of tannic acid, dilute mercurial ointments, creosote ointment ʒj. to ℥j. of cerate, solutions of carbonate of soda and of quinine, may be found useful.

In the treatment of this form of ozæna, Trousseau speaks most favourably of the insufflation of various powders. Among those most generally applicable are the subnitrate of bismuth combined with an equal proportion of talc; chlorate of potass by

itself, or with seven or eight parts of sugar; borax, similarly diluted; the ammoniochloride of mercury powder, eight grains to an ounce of sugar; calomel, with twenty to thirty parts of talc, &c. The effects of the insufflation of the mercurial powders should be very carefully watched, and the insufflation should not be too frequently repeated. Two or three times a day is generally often enough. But the other powders may be used much more frequently, almost *ad libitum*. In all cases it is important to wash out the nose thoroughly before blowing in the powders. It not unfrequently happens that the thorough cleansing of the cavities and subsequent insufflation of the powder is followed by the abolition of the foul odour, for the odour belongs to the discharge, but when the discharge collects again the odour returns.

The best instrument for blowing the powders into the nose is Rauchfuss's Insufflator (fig. 145). The powder is introduced into the tube through the opening (*a*), which is then covered over by the sliding tube (*b*), the extremity (*c*) is introduced into the nasal cavity, and then by a sudden compression of the india-rubber ball (*d*) the powder is driven out, and diffused in all directions.

Fig. 145.—Rauchfuss's Instrument for blowing Powders into the Nose.

Many of these cases require great perseverance, and some of them have seemed to be benefited by nothing. For such as resist the treatment indicated above, we have the resource of Rouge's operation.

Blood-Tumours and Abscess of the Septum.

Blood-tumours of the septum are always the result of injury. They are often accompanied by fracture, and usually affect both sides of the bone.

The mucous membrane is raised by the effusion, and forms a swelling which may even be sufficient to impede respiration.

Treatment.—If any treatment is thought necessary, the local application of cold may be resorted to.

Abscess of the septum may be acute or chronic. The acute form is usually caused by injury. The integument of the nose becomes œdematous and tender on pressure; the pituitary membrane is inflamed, and the portion covering the septum is uniformly turgid; the secretion of mucus is diminished; and there is more or less febrile disturbance. At a later period matter is formed beneath the mucous membrane; and a prominent swelling, causing proportionate obstruction, appears in one nostril or both. The inflammation may spread to the frontal sinuses and lachrymal passages; and headache and epiphora may result. Sometimes the lower margin of the septum and the upper lip become affected. The swelling itself is red, shining, tender, and fluctuating on pressure.

Treatment.—As soon as matter has formed it should be evacuated by incision, in making which, the thickened state of the mucous membrane must be borne in mind. The opening must be kept patent as long as any pus is secreted, and the inflammation allayed by warm fomentations.

Chronic abscess of the septum sometimes commences without any assignable cause and progresses very insidiously. The inflammatory stage is sometimes so slight as to pass unheeded; and the patient is not aware that anything is the matter till the abscess is fully formed; and then suffers not so much from actual pain as from uneasiness felt in the nares. In these cases the outer surface of the nose is never involved. In this form of abscess there is less redness, tension, and tenderness on pressure than

in the acute form. The abscess, besides, is more extensive, and more likely to occur singly on either side of the septum. It may communicate with a collection of fluid situate outside the nose—in the upper lip, for example. The matter secreted has sometimes a highly offensive smell.

The swellings formed by such abscesses may possibly be mistaken for polypi, unless care is taken in the diagnosis. They are still more likely perhaps to be confounded with the thickened elongated condition sometimes presented by the mucous membrane of the septum.

These abscesses should be opened early; and care must be taken to prevent the re-accumulation of matter, by passing a probe into the opening daily; or the cavity may be syringed with a weak detergent solution.

A guarded prognosis should always be given in these, as in other affections of the septum; for there is always danger of the destruction of parts of the bones or cartilages, which sometimes results in the formation of a permanent opening through the septum.

If such an opening through the septum be small, a very disagreeable whistling is sometimes produced when the patient speaks. In such cases the opening may be enlarged with benefit.

New Growths.

Various forms of new growth are met with in the nasal cavities. They may be classified as follows:—

1. Papillary growths.
2. Polypi.
   (*a*) gelatinous.
   (*b*) fibrous.
   (*c*) malignant.
3. Cartilaginous and osseous growths.

Papillary Growths.

Cases occasionally, though rarely, occur in which the nostrils are obstructed by papillary growths springing from the mucous membrane. Such growths bear a general resemblance to the papillomata of the mucous membranes of other parts, and are sometimes associated with similar growths upon the palate. They are usually, if not invariably, met with in children or young people. They give rise to a variable amount of irritation, and if extensive, obstruct the respiration and alter the voice.

They should be removed by scissors, and the base touched with solution of iron.

Mucous, Gelatinous, or Vesicular Polypi.

These are by far the most common of all the abnormal growths met with in the nasal cavities. They may be regarded as localised hypertrophies or outgrowths of the mucous membrane and submucous tissue. They are soft and somewhat elastic in consistence; of yellow or grey colour, and shining and semi-translucent appearance. They are, as a rule, pedunculated and pendulous, and may be more or less easily moved by the finger or a probe. Sometimes they are moved to and fro during respiration, and may be brought to a lower level by forcible expiratory efforts. They occur singly or in numbers. Sometimes they are irregularly lobulated, and fit themselves to the cavities in which they lie. When incised and submitted to pressure a variable quantity of fluid exudes. Superficially, they are often seen to be traversed by a few fine blood-vessels.

Microscopical examination shows that these polypi are related to the 'myxomatous' tumours of Virchow. They consist of extensions of the mucous membrane, including more or less closely reticulated fibro-cellular structure, which is continuous with the normal submucous tissue. Their surface is covered by ciliated epithelium;

and their substance is made up of delicate, wavy, interlacing filaments, the interstices of which are occupied by fluid, or semi-fluid material, containing round, oval, elongated, or caudate cells with nuclei, and very fine granules or molecules. The normal mucous glands, according to Billroth,[1] are enlarged and converted into lobulated growths with very numerous sacculi, and these help to make up the mass. In some cases these sacculi become cystic in appearance, and the 'vesicular' character of the polypi is pronounced. In other cases the connective-tissue elements are developed in larger proportion, and the growths are consequently firmer and denser and approach in character the fibrous polypi. Occasionally the softer polypi become comparatively condensed and opaque in places; and in some rare instances concretions of fibro-cartilaginous hardness are found in them.[2]

These polypi are most frequently connected with those portions of the mucous membrane which cover the superior and middle turbinated bones and line the superior and middle meatuses. Sometimes they arise in the lower meatus, or are attached to the inferior turbinated bone; sometimes they spring from the roof of the nose; occasionally they grow from the ethmoidal cells, or even from the frontal sinuses into the nasal cavities. But they very rarely, if ever, spring from the mucous membrane covering the septum.

In cases in which there are several distinct polypi, the lowest or most anterior, having the open nostril before them, make their way downwards uncompressed; but the others are kept up and hidden from sight, and become more or less compressed and hindered in their growth. For this reason, if the lowest only is removed, those above descend and rapidly increase in size. Sometimes they grow chiefly backwards, and may then hang down into the pharynx.

It is very rare to see any material alteration of the shape of the nose produced by the growth of this form of polypus.

The earliest *symptoms of mucous polypus* in the nose are a sense of fulness and weight in and about the nostril affected; frequent sneezing; and more or less mucous discharge. For a long time before the growth becomes visible, the patient seems to be always 'catching cold.' As the growth increases other symptoms supervene; respiration through the nose becomes more embarrassed; the patient cannot blow through the affected nostril, or the air passes with a whistling noise; he is obliged to keep his mouth constantly open; during sleep he lies with his head thrown back, and often snores; the voice is more or less affected, and becomes thick, indistinct, and 'nasal' in character; the sense of smell is impaired, or altogether abolished; the sense of taste is affected in so far as it is dependent upon a perfect condition of the olfactory organs; deafness sometimes occurs, either from obstruction to the Eustachian tubes, or from coexistent thickening of the lining membrane of the tympanum, there is increased mucous discharge, which is rarely offensive. Occasionally, but not often, there is epistaxis, in this respect contrasting with fibrous polypi and malignant growths. Sometimes the lower orifice of the nasal duct becomes obstructed, and there is overflow of tears. These various symptoms become aggravated in damp, and somewhat alleviated in dry weather; for the polypi are 'hygrometric' in character, and are notably affected by the state of the atmosphere. In dry, warm weather they contract; and in moist or wet weather they enlarge, and become fuller, and paler in colour. Sudden atmospheric changes are liable to give rise to severe fits of sneezing.

The diagnosis may usually be made secure by rhinoscopic examination, though in the early stages of the disease it is not always possible to obtain a view of the growths or to reach them with the finger.

In doubtful cases much assistance may be obtained from the administration of an anæsthetic, and the careful exploration of the nostril with the finger.

It is well to remember that hypertrophy of the mucous membrane covering the

[1] See Weber, in 'Pitha und Billroth,' *op. cit.* p. 203. Billroth, *Ueber den Bau der Schleimpolypen.* Berlin, 1855.

[2] See case referred to by Gross, *op. cit.* vol. ii. p. 338.

inferior turbinated bone may produce some of the symptoms of polypus, from which it is to be distinguished by its immobility and difference in colour.

The most important point in the diagnosis is to distinguish the benign mucous polypus from other growths of more serious nature. The light colour, semi-translucency, and soft elasticity of the mucous polypus; its slow progress, the absence of frequent hæmorrhages, and the general good health of the patient, serve to distinguish this growth from the fibrous polypus, which is more or less red in colour, opaque, and resistant, and which usually increases rapidly, undergoes no change of volume with change of weather, and is usually accompanied by frequent epistaxis. Malignant growths may be distinguished by their colour, opacity, consistence, and fixity, as well as by their proneness to bleed when touched, and by the comparative foulness of the discharge to which they give rise.

Osseous and cartilaginous growths are distinguished by their hardness, fixity, origin, and mode of growth.

Mucous polypi are always very troublesome, but rarely lead to serious results. Now and then they subside, and a spontaneous cure is effected. But it is never worth while to await such a result; for the growths may almost always be removed without much pain, and with scarcely any risk. They are, however, very liable to grow again, especially if any portions are left unremoved, or the patient is unwilling to persevere in the necessary course of treatment.

Treatment.—The only treatment that can be recommended is the removal of the growths by operation as completely as possible.

Attempts have been made from time to time to obviate the necessity for operative measures by the use of various escharotic, astringent, and exsiccative applications. 'Dr. J. H. Reeder of Illinois published the particulars of two cases in which prompt cures were obtained by strong injections of the tincture of perchloride of iron, aided by the application of a piece of sponge moistened with a solution of this article to the cavity of the nose.'[1] Mr. Erichsen refers to a case in which 'after the assiduous use of chloride of zinc injections, a very copious discharge of large sloughy polypoid masses took place from one nostril, which had been blocked up for many months previously.'[2] Nélaton recommends in some cases the repeated application of solid nitrate of silver;[3] and Mr. Bryant has advocated the insufflation of tannic acid in powder.[4] But as a rule such kind of treatment is only palliative, and is not productive of any permanent benefit.

Various methods have been devised for the removal of nasal polypi by operation. That most commonly adopted consists in the avulsion of the growths by means of forceps. The forceps should be about seven or eight inches in length, and strong, but as slender as may be consistent with strength. The blades should be grooved longitudinally, and well serrated along their edges. They may be curved or straight. In most cases straight, or nearly straight, forceps are best, but if the polypi are situated far back, or hang down into the pharynx, and have to be removed through the mouth, curved forceps are required.

The patient should be seated with his head thrown back and supported by an assistant, in such a posture that the cavity of the nostril is well illuminated. The tip of the nose is elevated by the operator's left thumb, or the nostril is dilated by a speculum.

The point of attachment of the polypus having been ascertained as exactly as possible, the growth should be seized close to its root, and twisted or torn off by steady traction and appropriate movements of the forceps.

It is sometimes convenient to pull gently upon the body of the polypus with one pair of forceps, while the blades of a second pair are slid gently along its neck until the root be reached and grasped.

When all the visible growths have been removed, the nostril should be carefully explored with the finger, as other small ones may often be thus detected and removed.

It is seldom necessary to give an anæsthetic, and if the patient have moderate

[1] Gross, *op. cit.* vol. ii. p. 340.
[2] *Science and Art of Surgery*, vol. ii. p. 287.
[3] *Pathologie chirurgicale*, tome ii. p. 679.
[4] *Lancet*, Feb. 1867, p. 235.

resolution it is undesirable to do so, for a good deal of assistance may be obtained from the patient blowing through the nostril, and thus clearing it of blood, and bringing down the growths.

When the polypus is situated far back and hangs down into the pharynx, it may sometimes be seized and removed by means of properly curved forceps introduced through the mouth. But it is generally easier to detach the polypus by means of forceps introduced through the nostril, and then to push it on into the throat.

In some instances polypi may be successfully removed by the fingers alone. One forefinger is thrust into the affected nostril, and the other is introduced into the posterior nares through the mouth. When the growth is reached, and held between the two fingers, it is pushed backwards and forwards until all resistance has ceased, and it is then withdrawn through the nearest opening.

Some surgeons advocate the removal of polypi with a wire snare, such as that invented by Mr. Hilton; and Dr. Thudichum uses for the purpose the galvano-caustic wire, by which the growth is burnt off.

My own belief is that nothing is so convenient or effectual as avulsion by forceps; for if the blades move with perfect smoothness (a very important point), and are held lightly by the fingers, the surgeon can feel his way with them up to the root of the polypus, and thus ensure its complete removal.

The objection sometimes advanced to the use of the forceps, that it is apt to lead to the removal, with the polypus, of a portion of the mucous membrane from whence it grows, does not seem to me to be material. For the loss of a little piece of mucous membrane, or even of a fragment of the turbinated bone, is not of the slightest consequence, whereas the removal of the whole of the polypus is essential for the cure; and in cases in which troublesome recurrence has taken place, it is quite justifiable to remove intentionally the portion of bone to which it is attached.

The hæmorrhage, though sometimes free, usually ceases spontaneously, or may be easily arrested by the injection of cold water or astringent solutions. But, if the polypi be numerous, and there is much bleeding, and especially if the patient has suffered severely, it is better to defer the completion of the operation to a future period. And thus it often becomes advisable to operate on several occasions, and to remove the growths successively, rather than to overtax the endurance of the patient by attempting too much at a single sitting.

After the nostrils have been cleared of polypi, it is often possible to feel with the finger, or to see, upon the mucous membrane, numerous little gelatinous granulations or buds; in other cases the membrane is simply thickened and vascular.

In either instance it is advisable to apply for a time some astringent solution or powder; and in all cases, after the removal of polypi by operation, the nasal douche should be used for a few days.

In some cases the insufflation of tannic acid, or a mixture of one part of the ammonio-chloride of mercury to sixty of powdered sugar, proves of great service, either in hindering the development of fresh growths, or in aiding the destruction of such portions as may have had their vitality impaired by the operation. The little buds left upon the mucous membrane, if not destroyed, will almost certainly develop into fresh polypi, and hence the frequent recurrence of these growths after removal. In such cases I have lately adopted the practice of applying to the interior of the nostril the strong solution of perchloride of iron, and with very satisfactory results. It should not be used till a day or two after the operation, and is best applied by a piece of lint soaked in the solution and attached to forceps or a probe.

In one case I performed Rouge's operation to obtain more complete access to the nose for the removal of polypi.

A man, aged 50, was admitted into St. George's Hospital in Aug. 1875, with both nostrils full of soft polypi. He had had the polypi removed a great number of times, but immediate recurrence had always taken place, and he was anxious to know if something more effectual could not be done. He was an intelligent man, and I explained to him that I thought the growth could be more completely removed by Rouge's operation, to the performance of which he willingly consented. On August 27 I therefore lifted the nose after the manner described, dividing both septum and alæ. This gave a free access to the nostrils, and

I removed the growth easily, and also a number of minute buds from off the walls of the nose. He went home in a fortnight quite well, and at the end of the year there had been no recurrence.

I do not think, however, that this somewhat severe operation can often be necessary for the cure of polypus, and at the time I resorted to it I had not used the perchloride of iron, which I have since found so efficacious in preventing recurrence.

Fibrous Polypi.

Fibrous polypi are by no means so commonly met with in the nasal cavities as the softer growths described in the preceding pages, but they are far more formidable. If allowed to take their course, they give rise to the most serious results. Their extirpation is often very difficult, and sometimes impracticable; and, moreover, the operative measures requisite may be attended by considerable risk.

These growths spring from the periosteum, and are connected with it by continuity of structure. They are covered by an extension of the mucous membrane, sometimes comparatively thick, but more frequently thinned away. As a rule, they occur singly, but in some rare instances two or more distinct growths have been found.[1] They vary very much in shape and size, but as a rule they are elongated and of very irregular contour, presenting finger-like prolongations, rounded out-growths, or broad based lobules in those parts which have encountered least resistance. They are firm and resistant to the touch, and are sometimes of almost cartilaginous hardness. They are opaque and usually more or less red in colour—in some cases comparatively pale, in others dark or even purplish red. When removed from the body, they are generally dull white or yellowish. But the tint varies in different specimens, and in different parts of the same specimen. They are traversed, not only superficially, but also throughout their substance, by numerous thin-walled blood-vessels, which are sometimes varicose. Hence their proneness to bleed. They are composed for the most part of closely-woven strands of white fibrous tissue, which spread out from the pedicle. They contain very few elastic fibres. In different specimens a variable proportion of spindle-shaped nucleated cells, similar to those of sarcomatous growths, are to be found.

Instances are on record in which deposits of carbonate and phosphate of lime have taken place on the surface of these growths,[2] as well as others in which the growths themselves have undergone a process of partial calcification.[3]

Fibrous polypi occasionally spring from the periosteum of the lateral walls of the nasal cavities or pterygo-palatine fossæ, or from the floor of the nose.

In some instances they appear to have originated in the antrum, and to have extended from thence into the nose. But in many cases, in which they have been supposed to have taken such a course, further investigation has shown their origin to have been very different.[4]

There can be no doubt, however, that polypi of the kind under discussion most frequently take origin from the periosteum of those portions of the base of the skull which form the roof of the naso-pharyngeal cavity. In such case they are called 'naso-pharyngeal polypi.'

The periosteum of the basilar process of the occipital bone, the body of the sphenoid bone, and the immediately adjoining parts, is peculiarly thick and vascular. The blood supply is very free, and derived from several different sources; hence, perhaps, its liability to give origin to new growths, and the rapidity with which such growths often increase in size.

The naso-pharyngeal polypi, properly so-called, invariably spring from some part or other of the limited area thus indicated. They are, however, prone to acquire

[1] MM. Lallemand and Cruveilhier record the case of a young man in whom were found, on post-mortem examination, two polypi of the kind under discussion. One grew from the posterior part of the superior turbinated bone and adjoining parts on the left side, the other from below the opening of the sphenoidal sinus on the right side.—*Dict. en 60 vol.*

[2] H. Cloquet, *op. cit.* p. 688. [3] Bourdilliat, *Gazette médicale*, 1868; 'Fibrome calcifié.'

[4] This was notably the case in the very remarkable instance narrated by Mr. Prescott Hewett, *Med.-Chir. Trans.* vol. xxxiv.

secondary attachments, and thus may arise various sources of difficulty in arriving at a satisfactory conclusion as to their point of origin. Sometimes they become adherent to the walls of the nose, and consequently may be supposed to be nasal polypi. Occasionally they extend down behind the pharynx, and in such cases may appear to have arisen from the anterior surface of the spinal column.[1]

Whatever their origin, these polypi increase in size with comparative rapidity. At first they mould themselves somewhat to the cavities in which they lie, and grow forwards, or backwards and downwards, in the direction of least resistance. When more advanced, they exert injurious pressure from within upon the walls of the nasal cavities, and in a certain sense overcome the resistance they encounter. They are liable to cause ulceration and destruction of the mucous membrane, perforation of the septum, and expansion and displacement of the nasal bones and superior maxillæ; or gradual thinning and absorption of these bones may result from the pressure to which they are subject. The palate is pressed downwards and forwards; and the cavity of the mouth is encroached upon. In all such cases the visage is proportionately distorted. The cheeks become more or less prominent, and the nose expanded and flattened. The eyes appear, or actually are, more widely apart than natural. The general aspect thus produced is very characteristic. It has been not inappropriately termed 'frog-face.' In some cases the distortion is symmetrical. In others, one side is more obviously distorted than the other. If one side only of the face is affected, the other remaining perfectly natural, the presumption is that the disease, whatever it may be, is in the antrum rather than in the nose, although the cavities of the latter may be encroached upon.

In the earlier stages the *symptoms* are similar to those produced by the mucous polypi, and it may be difficult to make the diagnosis. But the fibrous growths are firmer and more fixed than the mucous, and they do not undergo any change of volume under different atmospheric conditions. The symptoms, therefore, are more severe and more constant, and when the nose is once blocked, the obstruction to respiration is more absolute and unyielding. Moreover the fibrous polypi give rise to frequently recurring epistaxis. This is not only a very characteristic symptom, but it may prove the source of much anxiety and danger. The discharge from the nose associated with the presence of a fibrous polypus is as a rule more scanty, and thinner, more sanious, and more liable to become foul and ozænic than the mucous discharge usually associated with the presence of the softer growths.

In the later stages, when the polypus can be distinctly seen and felt by the surgeon, and still further when from its size it has caused distortion of the face there can be little or no difficulty in making out the nature of the growth, whatever doubt there may remain as to its precise origin and connections. Careful exploration, and pressure in different directions alternately by the fingers, and the passage of a bent probe round the free parts of the polypus, first on one side, then on the other, may often afford reliable indications of the probable position of the original pedicle, as well as of such secondary attachments as may have been formed.

Naso-pharyngeal polypus, if left to pursue its course, soon presses upon the soft palate, and thus interferes with easy deglutition, and gives rise to frequent inclination to vomit. Sometimes, when attempts are made to swallow, liquid portions return through the nose. As the malady advances, thin, sanious, or purulent, and sometimes fœtid discharges begin to flow more or less abundantly from the nostrils, and the epistaxis becomes more frequent and more severe. The growth generally enters one side of the nose first, and then invades the other either by penetrating the septum or by growing round its posterior border. Still later, the spongy bones and septum become more or less extensively destroyed, in consequence of the pressure of the growth. The nasal bones and superior maxillæ also become destroyed to a

[1] These several points are ably discussed in the Treatise of Dr. Robin Massé, *Des Polypes naso-pharyngiens*, Paris, 1864; and also in the elaborate essay of M. d'Ornellas, *Des Polypes fibreux de la base du Crâne, dits naso-pharyngiens*; Paris, 1854. And in the essay by M. Beuf on the same subject; Paris, 1857. Also by M. Brevet, *Des Polypes naso-pharyngiens*; Paris, 1855.

variable extent, or expanded and pushed to either side; and the countenance is consequently distorted. Sometimes the growth enters the maxillary sinus, and presses upon the floor of the orbit; sometimes it seems to pass round the bone (or through it), and issues under the skin of the cheek, passing along the cutaneous aspect of the bone, and pressing together the walls of the antrum.[1]

Sometimes the growth sends off prolongations through the sphenopalatine and sphenomaxillary openings, and even extends under the zygomatic arch into the temporal fossa. MM. Maisonneuve and Chassaignac record cases in which growths of this kind had penetrated the pterygomaxillary fissure, and passed through the pterygoidean space between the muscles towards the face.[2] In other cases extensions are sent into the frontal and sphenoidal sinuses. And in others, again, prolongations may pass through the sphenomaxillary fissure into the orbit, with or without destruction of bone, and so cause protrusion of the eyeball.[3] As a further consequence, the optic nerve may be put on the stretch, and vision may be impaired. Very frequently the orifices of the Eustachian tubes are obstructed, and the sense of hearing is dulled. Very frequently, also, the nasal ducts are compressed, and more or less constant epiphora results. But the most serious consequences follow when, as occasionally happens, the growth penetrates to the interior of the skull. In such case no treatment is of any avail. The growth may enter the skull either through the sphenoidal fissure, or, after having caused absorption of bone, from the sphenoidal cells, or through the cribriform plate of the ethmoid bone. Suppuration, compression of the brain, coma, and death, are the results to be looked for.

A remarkable illustration is recorded by Samuel Cooper as having come under observation at St. Bartholomew's Hospital. The patient suffered from an enormous polypus, which occupied both nasal fossæ. The eyes were four inches apart, and the left eye was absolutely blind. Paralysis supervened fifteen days before death, which followed a period of coma. On post-mortem examination, it was found that a portion of the growth almost as large as an orange was within the skull. The anterior lobe of the left hemisphere of the brain was almost entirely destroyed.

These growths are much more frequently met with in males than in females. They may occur at almost any age, but are most common in young people.

As already indicated, these growths not only give rise to considerable disfigurement and severe suffering, but sooner or later may prove fatal in result. Death may ensue from exhaustion caused by repeated hæmorrhage, constant discharge, disturbed sleep, and inability to take sufficient food; or from slow or even rapid asphyxia; or from implication of the nervous centres.

Treatment.—Complete extirpation of the growth by operation is the only treatment upon which any reliance can be placed.

In some rare instances, it is true, naso-pharyngeal polypi have spontaneously sloughed away. In the case of a young woman in St. George's Hospital, Mr. H. C. Johnson 'proposed to divide the soft palate, and endeavour to remove the whole growth from the pharynx; when, fortunately for the patient, the morbid tissue was attacked by rapid sloughing, which so entirely removed it, that no trace could be discovered of any part remaining.'[4]

A somewhat similar result occurred in the case of a boy under the care of Mr. Birkett, in Guy's Hospital. In this case it was proposed to extirpate the polypus after removal of the upper jaw; but the parents would not consent. On one occasion hæmorrhage took place to such an extent as to render necessary the application of a ligature to the common carotid artery. The tumour subsequently sloughed, and the whole came away through a large opening in the cheek. Seven years afterwards the patient was quite well. The sinus in the cheek had healed up. There was no recurrence of the growth.[5]

Instances are also recorded by Saviard,[6] Bonnet,[7] Vimont,[8] and others.[9] But so fortunate an issue is far too rare to justify the expectation of its occurrence.

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[1] See Mr. Hewett's remarkable case published in *Med.-Chir. Trans.* vol. xxxiv.
[2] Massé, *op. cit.* p. 17.
[3] See case under the observation of M. Chassaignac, quoted by Massé, *op. cit.*
[4] *British Medical Journal*, vol. i. 1858. p. 61.
[5] *Ibid.* p. 119.
[6] *Recueil d'Observations chirurgicales*, p. 112. Paris, 1784.
[7] Bonnet, tome iv. obs. 92, p. 457.
[8] Quoted by Brevet, *Des Polypes naso-pharyngiens*, p. 16. Paris, 1855.
[9] See the treatises by Robin Massé and D'Ornellas, already referred to.

In some cases the growth can be twisted off its base by forceps introduced through the anterior nostril or the pharynx; or it may be possible to pass the wire of an écraseur round the root of the tumour and thus remove it, either by tightening the wire or by using it as a galvano-cautery.[1]

Occasionally also it may be practicable to detach the polypus by the forefingers introduced simultaneously into the anterior and posterior nostril, the tumour being then pushed forwards and backwards until it comes away.

There are, however, but few cases of fibrous polypus to which these methods are applicable. In most instances, the size of the growth, the position of its attachments and its extension into adjacent cavities, render necessary some surgical operation by which more free access is given to it than is possible through the natural openings. It is usually found most convenient to reach the tumour from the front, either by Rouge's operation, described at page 643, or by dividing one nostril at its junction with the cheek, or by the removal or temporary displacement of the whole or part of the upper jaw.

It is possible also to reach the growth from below by division of the palate, as recommended by Nélaton.[2] But this method has the obvious disadvantage that the growth is attacked at the part which is usually farthest from its origin.

Rouge's operation seems to me to be excellently adapted to many of these cases, and has the recommendation that it leaves no visible scar.

In some cases it suffices to open up the nostril by dividing the ala at its junction with the cheek, then cutting through the bones in the same direction, and turning up the side of the nose towards the middle line.[3] If the tumour has attained a large size, and has extensively invaded the adjacent cavities, it is best dealt with by removal of the upper jaw.

Ablation of the upper jaw to facilitate the removal of a naso-pharyngeal polypus appears to have been first suggested by Whately, and first practised (though with incomplete success) by Syme, in the year 1832. To continental surgeons, however, is due the credit of having fully established the practicability and the value of this operation.[4] It is now generally recognised as a legitimate and successful surgical procedure. Mr. Tatum appears to have been the first in this country to have operated with successful results.[5]

The various operative proceedings for the total or partial resection of the upper jaw will be found described in the essay on Diseases of the Mouth.

It fortunately happens that in most cases partial resection of the maxilla suffices to afford the requisite space. The floor of the orbit,[6] and even the dental arch, may be left intact.[7]

A good example of partial resection of the maxilla for the removal of a naso-pharyngeal polypus is recorded by Mr. Pick as having come under the care of Mr. Holmes in St. George's Hospital[8] in the year 1866. The patient (a man), twenty-seven years of age, suffered from characteristic symptoms. 'The operation was commenced by a single incision from the inner canthus of the eye, down the side of the nose, and continued through the upper lip in the mesial line. The flap having been dissected up, the bone was first divided by a key-hole saw through the malar tuberosity: the bone was then divided into two, leaving the floor of the orbit, by the bone forceps, carried along the lower margin of the orbit. The other attachments having been divided in the usual manner, and the bone having been severed from the soft palate, it was easily removed, and the origin of the tumour from the base of the skull exposed. The polypus was now grasped, and easily extracted. . . . The flap was readjusted. . . . There was very little bleeding during the operation. . . . The man

[1] Bryk, *Wien. med. Halle*, 1862, p. 223. This method appears to have been first employed by Middeldorpf, in 1853. See Robin Massé, *op. cit.* p. 73.

[2] *Bulletin de la Société de Chirurgie*, vol. i. p. 159.

[3] See a case of Mr. Hewett's, related by Mr. Pick. *St. Geo. Hosp. Reports*, vol. ii. p. 165.

[4] A full history of the operation, and copious details of the various modifications adopted by different surgeons, are given in the already quoted treatise of Dr. Robin Massé.

[5] *British Medical Journal*, January, 1858, p. 119.

[6] Guérin, *Eléments de Chirurgie opératoire*, p. 228. Paris, 1858. Maisonneuve, *Gazette des Hôpitaux*, août 21, 1860.

[7] Bérard, *Dictionnaire en 30 vol.* tome xxviii. p. 367.

[8] *St. George's Hospital Reports*, vol. ii. p. 162.

made a good recovery, and left the hospital with the wound quite healed, five weeks after the operation.' The growth recurred, and was again removed eight years after the original operation.[1] He has since remained free from any return of the disease, and was seen a few weeks ago in perfect health. The polypus on both occasions was of a purely fibrous structure.

These operations upon the upper jaw, and the removal of vascular polypi from the base of the skull, are sometimes attended with a good deal of hæmorrhage, so that there is some danger, if the patient is under the influence of an anæsthetic, of blood entering the trachea. If the tumour is very extensive and vascular, it may be therefore worth while to perform tracheotomy as a preliminary precaution, though with efficient assistance this is not often necessary. A thin flat sponge tied to a string, and pressed against the floor of the nose and back of the pharynx, will be found useful.

But the safest plan is of course to dispense with an anæsthetic, if the patient will allow the operation to be performed without it. Mr. Holmes has referred to three cases,[2] one of which occurred to myself, in which the patient has suffered the operation of removal of the upper jaw without an anæsthetic. Another method is the 'osteo-plastic' operation of Langenbeck[3] by which the soft parts and the bone are divided along the same lines, which are those for the ordinary resection of the jaw, excepting that the connections of the nasal and frontal bone to the maxilla are left undivided; the jaw and its coverings are then turned inwards and upwards, and the tumour removed from behind, after which the parts are replaced and fixed by deep sutures.

By whatever operation the polypus is exposed, great care must be taken to remove it as completely as possible. The actual cautery should be at hand, not only for the arrest of bleeding, but also for the destruction of any portion of the root of the tumour which may remain adherent to the periosteum.

Malignant Polypi.

The various forms of sarcomata and carcinomata are met with in the nasal cavities, sometimes growing directly from their walls, in other cases invading them from a neighbouring origin.

They generally occur either in young children or in old persons.

Such growths not only expand, but infiltrate the tissues of the nose; they grow quickly, bleed on slight provocation, and give rise to foul discharge and much pain.

If recognised in the early stage, the tumour and its connections should be freely and widely extirpated. Of course there is great danger of a return of the disease, but life may sometimes certainly be prolonged by the operation.

If the disease be advanced, no operative proceedings are to be recommended.

Cartilaginous and Osseous Growths.

Cartilaginous growths are occasionally seen in the nose, and are almost always attached by a broad base to the septum. They cause inconvenience by blocking up the nostril and obstructing respiration, and are sometimes attended with troublesome sneezing and coryza. The few cases I have seen have all been in young people.

The growth is easily removed by the knife or scissors.

Exostoses springing from some part or other of the nasal parietes, or from some neighbouring bone, may invade the cavities of the nose, and give rise to symptoms more or less resembling those produced by other growths. The degree of hardness and fixity presented on careful exploration establishes the diagnosis. Very considerable disfigurement may sooner or later result.

In some cases cartilage in variable proportion, and variously disposed, enters into the formation of growths of this kind.[4]

[1] *Clin. Soc. Trans.* vol. viii. p. 68.
[2] Holmes, *Surgery, its Principles and Practice*, p. 592.
[3] *Deutsche Klinik*, 1861, p. 281; and Schmidt's *Jahrb.* vol. cxiii. p. 195.
[4] A remarkable case of this kind is related in *Guy's Hosp. Reports*, ser. i. vol. i. p. 403.

Besides these exostoses, there is another kind of osseous tumour occasionally met with in the nasal fossæ and sinuses [1] of the face, which seems to originate from the mucous or periosteal lining of these cavities, rather than to grow like a true exostosis from their bony walls. These tumours, which may attain a large size, and produce great disfigurement, usually have their origin in the frontal sinuses or in the nasal fossæ; but they are prone after a time to become separated from their attachments, and are found loose in the containing cavity.

Their removal is to be accomplished by such operative measures as are necessary for the exposure of the cavity in which they are contained.

Arthur E. Durham, 1870.
Warrington Haward, 1882.

[1] Dolbeau, *Bulletin de l'Académie de Médecine*, tome xxxi. p. 107. Dr. Paul Olivier, *Sur les Tumeurs osseuses des Fosses nasales*; Paris, 1869. *Compendium de Chirurgie*, tome iii. pp. 98 et 564.

DISEASES OF THE LARYNX.

IN Laryngeal Diseases the ordinary symptoms, such as pain, cough, difficulty in breathing and in swallowing, alteration of the voice, &c., often fail to indicate the precise nature and seat of the malady.

Moreover, irritation of or pressure upon the recurrent or other nerves by tumours, aneurisms, &c., as well as certain morbid conditions of the nervous system generally, may give rise to symptoms which more or less closely simulate those produced by actual disease of the larynx itself. Hence it constantly happens that some aid to diagnosis must be obtained, or the treatment adopted is likely to be as unsuccessful in result as it is necessarily uncertain in direction. Such aid is afforded by the Laryngoscope. This instrument was suggested—indeed repeatedly suggested—many years ago, but it has only recently come into general use. Its great value as an aid in the diagnosis and treatment of diseases of the larynx, though fully established, was not yet generally recognised and appreciated when the First Edition of this work was published.

Historical details relative to the invention of the laryngoscope would be altogether out of place in these pages.[1] It may, however, be stated that Dr. B. G. Babington appears to have just claims to be considered the first successful laryngoscopist.[2] Further, it is impossible to omit an expression of grateful acknowledgment of the labours of Professor Czermak, formerly of Pesth.[3] To him, probably more than to any one else, we are indebted for the earliest complete demonstration of the general practicability and value of laryngoscopical examinations, and the best methods of making them, and still more, perhaps, for the disinterested and painstaking manner in which, both on the Continent and in this country, he has published his results, and personally taught his method.

Laryngoscopy.

The Laryngoscope essentially consists of the laryngeal speculum, together with some contrivance, by means of which a good light can be thrown upon it, when introduced into proper position in the pharynx.

The laryngeal speculum is a small plane mirror, fixed to one extremity of a slender but strong stem of sufficient length. The other extremity of the stem is fitted into a light handle, either permanently or in such manner that it can be removed or changed at will. The mirror may be of polished steel, speculum metal, or silver; or it may be made of silvered glass (looking-glass), mounted in a thin

[1] The history of Laryngoscopy is more or less completely discussed in the following works:—*The Use of the Laryngoscope*, by Morell Mackenzie, M.D., 3rd edit. London, 1871. *The Laryngoscope in Diseases of the Throat*, by Sir G. D. Gibb, M.D., 3rd edit. 1868. Art. by Mr. Windsor in the *Med.-Chir. Review*, Jan. 1863. Art. 'Laryngoscope' in the *Dict. encyclop. des Sciences médicales*. Paris, 1868. *Klinik der Krankheiten des Kehlkopfes*, by Dr. Ludwig Türck. Wien, 1866. *Die Laryngoskopie*, by Dr. Bruns. Tübingen, 1865. *Lehrbuch der Laryngoskopie*, by Dr. Tobold. Berlin, 1863. In these works may also be found much valuable information relative to the construction and practical uses of the laryngoscope, as well as to the diagnosis and treatment of Diseases of the Larynx. Constant reference has been made to them in preparing the following pages.

[2] *London Medical Gazette*, vol. iii. p. 555. London, 1829.

[3] *Zeitschr. der Ges. der Aertze*, No. 17. *Der Kehlkopfspiegel und seine Verwerthung für Physiologie und Medizin*. Leipzig, 1860. *Du Laryngoscope*. Paris, 1860. A translation of this work was published by the Sydenham Society in 1861. Also many subsequent contributions to Foreign and British journals.

metal frame. The metallic mirrors are readily warmed, retain their heat well, and are so thin as to occupy but little space. On the other hand, the silvered glass mirrors are much less liable to get tarnished or scratched; no practical disadvantage arises from their comparative thickness, and there is no difficulty in keeping them of such temperature as to prevent the deposition of moisture upon them. They are, therefore, as a rule to be preferred.

In shape the mirror may be circular, ovate, elliptical, or quadrilateral with rounded angles. The three first-named forms are recommended by Türck,[1] the last by Czermak.[2] For all ordinary examinations the circular and quadrilateral forms are the best, and they answer equally well. In cases, however, in which it may be necessary to carry the speculum deeply into the pharynx, or in cases in which the tonsils are much enlarged, the ovate or elliptical form is preferable.

The mirrors ordinarily supplied by the makers vary in diameter from half-an-inch to an inch or more. In every case the larger the mirror that can be employed the better is the general view obtained. The stem should be straight, or only slightly curved, and four or five inches in length. It should form with the diameter of the mirror drawn to its point of junction an angle of from 120° to 125°. Moreover the mirror should be so inclined as to look somewhat downwards when the stem is held horizontally. It is advantageous to have the stem of such material that it may be bent in one direction or the other, so that different degrees of inclination may be given to the mirror according to the requirements of the case under examination.

For the illumination of the speculum when in position either direct or reflected light may be employed. But in either case, if the light should not be very powerful, concentration of the rays is desirable.

Direct sunlight answers perfectly, but is seldom available. Some other source of light *must* frequently, and *may* always be employed. Diffused daylight is rarely, if ever, sufficiently powerful.

The source of light is placed on one side of and somewhat behind the head of the patient, who should, if practicable, be seated near the corner of a table. The rays are then reflected from and concentrated by a circular concave mirror duly arranged immediately in front of the face of the surgeon. The mirror should be three or four inches in diameter, and should have a focal distance of about twelve or fourteen inches. It may be perforated or not in the centre. If perforated, it may be placed in front of one eye, and the view may be taken through the perforation. The hole in the centre should be oblong, its edges corresponding to the eyelids, so that its long diameter is transverse. If not perforated, it may be arranged in front of the forehead and nose, and between the eyes; or lower down in front of the nose and mouth. In either of these arrangements both eyes may be used; in the former looking below, in the latter above the reflector. The perforated reflector should theoretically give the more perfect view. But practically the imperforate reflector is found to be as efficient in all ordinary cases; and it possesses the great advantage of permitting the equal use of both eyes. The reflector may be held in the hand, when the hand is not required for any other purpose; or it may be supported on a stand in such a manner as to be freely movable in all directions. In Tobold's arrangement it is connected with the stem of the lamp, or the light-concentrator. Generally, however, it is attached to the head of the surgeon by means of a strong spectacle frame, an elastic frontal band, or a steel spring passing over the vertex. The first method is best adapted for the perforated reflector; the second for the imperforate reflector in front of the forehead; and the third if the reflector is worn lower down. Czermak's original plan of fixing the stem of the reflector at right angles to a piece of wood to be held between the teeth may be considered obsolete. In any case the reflector should be connected with its support either by a ball and socket joint, or in such other way as permits it to be turned easily in any required direction.

As a source of light, any lamp which burns with a bright, steady, full-bodied

[1] *Méthode pratique de Laryngoscopie*, par le docteur Türck. Paris, 1861; and *op. cit.* p. 38.

[2] *Du Laryngoscope*, par le docteur Czermak. Paris, 1860.

flame, may be employed. A good moderator or reading lamp, or an Argand gas-burner, answers perfectly well for all ordinary purposes. But it is desirable to have the lamp so arranged that it can be raised or lowered in position, and moved from side to side. Mackenzie's 'rack movement laryngoscopic lamp,'[1] which readily admits of perpendicular and horizontal movement, is admirably adapted for use in the consulting-room.

The light of the lamp may be advantageously concentrated by means of one or more lenses placed in front of the flame, and a concave reflector or white reflecting surface placed behind it. Of all the so-called 'light concentrators' which I have seen, I believe Mackenzie's is the best for ordinary use. It consists of a metallic cylinder having a short branch which bears a plano-convex lens two or three inches in diameter. The cylinder replaces the glass chimney of the Argand gas-burner; and its branch is so situated, and of such dimensions, that the lens is opposite the middle of the flame, and receives and concentrates a large body of luminous rays.

The general arrangements for making an ordinary laryngoscopical examination by means of the reflector and artificial light are represented in fig. 146.

The lamp, the mouth of the patient, and the eyes of the observer should be as nearly as possible in the same plane. If the laryngeal speculum is held in the right hand of the surgeon, the lamp should be placed on the right side of the patient, and

Fig. 146.

vice versâ. If, as may sometimes be convenient, the lamp is placed above and behind the head of the patient, the vertical plane must be preserved; but the speculum may be held with equal advantage in either hand without risk of obstructing the light.

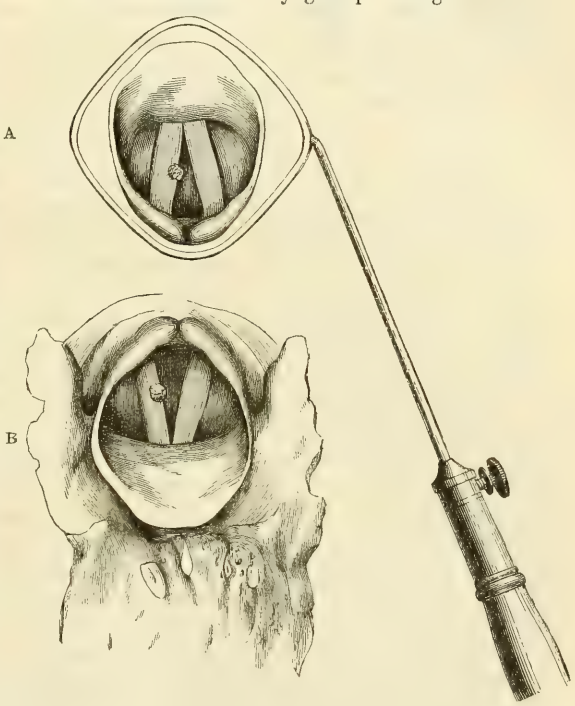
The patient should, if possible, be comfortably seated opposite the surgeon in a nearly erect position. His body should lean somewhat forwards, and his head should be inclined slightly backwards; but should not be thrown so far back as is often done. Sometimes it is advantageous to employ a 'head-rest,' which may either be fixed to the back of the chair, or may have a separate stand. When in proper position, the patient is directed to open his mouth as widely as possible, and to breathe quietly but deeply. His tongue may be protruded, and held by himself or by the surgeon, the fingers and thumb being covered by a soft towel or handkerchief to prevent slipping; or it may be kept within the mouth, and gently pressed forwards against the lower teeth, an attempt being made at the same time to depress and flatten or render concave its posterior part. Sometimes one plan, sometimes the other is found to be the more effectual. Meanwhile the surgeon arranges his reflector so as to throw the light into the open mouth of the patient. When he has succeeded in illuminating the middle of the soft palate, the uvula, and posterior pharyngeal wall by a bright disc of light, he may proceed to introduce the laryngeal speculum.

The handle of the speculum should be held somewhat 'pen-like' between the

[1] Made by Mayer and Meltzer.

thumb and the fore and middle fingers of one hand or the other. The speculum should be slightly warmed previous to its introduction, either over the lamp by momentary immersion in hot water, in order to prevent deposition of moisture upon its surface.[1] Care must be taken, however, that it is not made too hot. Its temperature may be easily tested by the hand or cheek of the surgeon. The speculum should be introduced with its reflecting surface directed downwards and forwards. It should be carried backwards through the cavity of the mouth, deliberately, confidently, and steadily, and then applied with gentle but firm pressure against the uvula and neighbouring portions of the soft palate. Uncertain, hesitating, and hasty movements of the instrument are liable to give rise to objectionable titillation. In its passage through the mouth, it should not come in contact with the tongue, nor, indeed, with any other parts than those against which it is to be placed. As a rule, it should not be carried so far back as to touch the posterior pharyngeal wall. Sometimes, however, especially in certain exceptional cases, this may be done with considerable advantage. The hand of the surgeon must be kept somewhat down and well towards its own side, so as not to obstruct the light. The third and fourth fingers may rest against the chin or cheek of the patient. The stem of the instrument should lie in or near to the corresponding angle of the mouth. In a large proportion of cases, no difficulty is encountered, and the patient suffers comparatively little inconvenience.

Fig. 147.—Diagram illustrating the antero-posterior reversal of the Laryngoscopic Image.



The small excrescence situated on the right vocal cord (B) might be falsely supposed to be on the left from the appearance presented in the mirror (A).

When the speculum is thus placed in position and well illuminated, it exhibits to the surgeon images of those parts of the larynx upon which the rays reflected from its surface are made to fall. It must be borne in mind, however, that as a necessary consequence of the position of the mirror in relation to the eye of the observer on the one hand, and to the larynx of the patient on the other, the parts appear in the image as though reversed antero-posteriorly. And they are thus conventionally represented in all ordinary laryngoscopic diagrams.

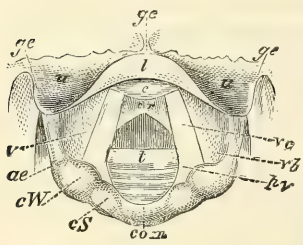
This so-called 'reversal' or 'inversion' of the image is illustrated by fig. 147, in which B diagrammatically represents the parts as seen when simply looked down upon, and A the same parts as they appear reflected in the mirror. No practical difficulty or inconvenience results from this apparent inversion.

By varying the inclination of the mirror, and slightly changing its position from time to time, the following parts, or rather certain portions of them, may be succes-

[1] Various expedients have been suggested with a similar view. Thus, Dr. H. G. Wright contrived a speculum, the temperature of which was maintained by a wire placed behind the mirror and heated by galvanic action. Dr. Buzzard recommends that the surface of the mirror should be covered with a film of glycerine. But no plan answers better than the simple one above-mentioned; nor is any other so easy of application.

sively brought into view; the base of the tongue and glosso-epiglottidean ligaments; the epiglottis and aryteno-epiglottidean ligaments; the cartilages of Santorini, and the arytenoid cartilages; the true and false vocal cords; the ventricles and anterior wall of the larynx, including a portion of the cricoid cartilage; more or less of the anterior wall of the trachea; and if the glottis is very widely open and the light very good, even the bronchi appearing as two dimly defined dark circles, and more rarely a small portion of the cavity of the right bronchus. These several parts, however, cannot all be seen with equal facility. Numerous rules have been laid down as to the position and degree of inclination of the mirror best adapted for the special examination of each particular part.[1] But it is needless to repeat them. A correct knowledge of the relative positions and natural appearances of the parts, and a consideration of the simplest laws of catoptrics, together with a certain amount of practical experience, will enable the laryngoscopist to bring into view and recognise one part after another so far as may be practicable. Repeated attempts are often necessary before even partial success can be attained. And sometimes even the utmost perseverance only results in failure. But this need rarely happen. The possible sources of difficulty are numerous, and the actual difficulties may be great; but they may generally be obviated or overcome, at any rate to some extent, by patience and judicious management. Those who suffer from chronic laryngeal affections are, as a rule, the best subjects for laryngoscopic examination—not the worst, as might be supposed. Their desire for benefit affords a stronger stimulus to patience and self-control than can actuate the healthy; and, moreover, they are usually already accustomed to expose their fauces for inspection, and to submit to local applications, by which indeed the normal sensitiveness of the parts may have been diminished.

Fig. 148.



ge, Glosso-epiglottic folds; *u*, upper surface; *l*, lip; *c*, cushion of epiglottis; *v*, ventricle of larynx; *ae*, ary-epiglottic fold; *cW*, cartilage of Wrisberg; *cS*, capitulum Santorini; *com*, arytenoid commissure; *vc*, vocal cord; *vb*, ventricular band; *pv*, processus vocalis; *cr*, cricoid cartilage; *t*, rings of trachea.

The most common sources of difficulty are as follows: general nervousness and excitability of the patient; fancied or real inability on his part to open his mouth sufficiently widely, and awkwardness in the management of his tongue; relative largeness, or some swollen condition of the tongue; malformation or deformity of the soft palate and neighbouring parts from ulcerative disease, and subsequent contraction of cicatrices; elongation and thickening of the uvula; enlargement of the tonsils; pendency of the epiglottis; and, lastly, extreme sensitiveness of the uvula and soft palate, either natural or resulting from existing inflammation or ulceration.

Difficulties arising from the first three sources may be overcome almost invariably by patience and judicious management on the part of the surgeon, and a little practice on the part of the patient. Hastiness in manner and in method of proceeding should be avoided; and every effort should be made to encourage, reassure, and inspire confidence. By his own example the surgeon should show the patient how to open his mouth, and should demonstrate the slightness of the inconvenience caused by the introduction of the speculum. If proper directions are given, and the patient is induced to practise occasionally by himself before the looking-glass, he will probably return in the course of a few days comparatively well able to display his fauces, and to submit to the needful examination.

By one or other of the methods already indicated (p. 658) the tongue may generally be kept out of the way. If, however, these methods fail, and the tongue still rises so high as to obstruct the view of the soft palate, &c., the patient should be directed to make a few deep inspirations, and alternate them with the repeated pronunciation of the broad vowel '*a*' (ah). He should breathe through the mouth only; not through the nose. In this way the tongue may often be brought into favourable position. Sometimes a broad spatula or tongue depressor may be advantageously

[1] Krishaber, Art. 'Laryngoscope,' in *Dict. encyclop.*, *op. cit.* p. 497 *et seq.* Türck, *op. cit.* and *Méthode pratique de Laryngoscopie.* Paris, 1861.

used. But, as a general rule, the introduction of any unnecessary instrument into the mouth should be avoided.

Occasionally by sliding the finger along the tongue (the speculum being at the same time introduced and illuminated), an effort at vomiting is produced, during which the tongue being depressed and the larynx raised, a good though a momentary view may be obtained.

In cases in which *the soft palate is unusually short, and the uvula small and thin*, the speculum is apt to slip up somewhat behind them, and to become partially hidden. Under such circumstances it is better to hold the instrument as nearly as possible in its proper position, without touching or resting against the soft palate.

An elongated and thickened uvula may obscure the view by hanging below, and turning round the inferior border of the speculum. The employment of a larger speculum, or a little manœuvring of the instrument, serves to obviate this source of difficulty for the time being; and it may be permanently removed by appropriate measures.

Considerable embarrassment is often caused by *chronic enlargement of the tonsils*. In such cases a narrow, elongated, elliptical speculum should be used, and carried somewhat more deeply into the pharynx than is usually necessary. Enlarged tonsils are often so little sensitive that the speculum may be pushed well in between them without causing much discomfort.

Pendency or projection backwards of the epiglottis is a frequent source of considerable difficulty. Gibb states as the result of his observations that some such abnormal condition is to be found in eleven per cent. of otherwise healthy individuals.[1] It depends upon undue elongation of the glosso-epiglottidean ligaments or folds of mucous membrane, together with relaxation or weakness of the muscular fibres they contain. The degree of obliquity observed varies greatly in different cases, and to some extent in the same case under different conditions. In some instances the epiglottis hangs almost horizontally over the entrance to the larynx; but more frequently its deviation from the normal erect position is comparatively slight, or even only occasional. Laryngoscopic inspection is of necessity proportionately impeded. The greatest difficulty is often experienced in obtaining a satisfactory view, and sometimes even partial success appears to be impossible.

In all cases of pendent epiglottis, it is necessary to carry the speculum further backwards and downwards, and to make its reflecting surface look more forwards than is desirable in the normal condition of parts. Sometimes its lower border must be placed against the posterior wall of the pharynx. When the speculum is in position, the patient should be directed to utter a series of short, high *staccato* notes, or to imitate a shrill *falsetto* laugh. During the emission of such sounds the epiglottis is suddenly raised, and jerked forwards. Opportunity may be thus afforded for a succession of brief glimpses of the interior of the larynx, which may suffice at any rate to determine the diagnosis. Another method which sometimes proves partially successful is as follows. The head of the patient is thrown back as far as possible, and his tongue is projected and held by himself. The speculum is introduced and inclined slightly backwards and downwards, and the surgeon having lowered his head, looks into it as it were from below upwards. At the same time with his free hand he presses the pomum Adami of the patient backwards and somewhat upwards.[2] There can be no doubt that the larynx may often be moved into a comparatively favourable position for inspection by external manipulation; but the method is liable to occasion much discomfort, and sometimes considerable pain.

In some instances, in spite of all attempts, the epiglottis still persistently hides the larynx from view. And in such cases it may be desirable to raise it mechanically by instrumental aid. Forceps, tenaculums, and hooked sounds of various kinds have been devised for this purpose by Bruns,[3] Voltolini, Fournié, Lewin, Mackenzie and

[1] *Op. cit.* p. 44.

[2] See Krishaber, *op. cit.* p. 493.

[3] Bruns appears to have been the first to have used an instrument of this kind; and he did so in the case of his own brother, who suffered from a polypoid growth in the larynx. The

others. But all such instruments are difficult for the surgeon to use, and still more difficult for the patient to tolerate. It is only in very exceptional cases that they can be employed with advantage. The epiglottis is extremely sensitive; but it bears firm pressure and a steady but gentle pull better than the uncertain titillation of a hesitating touch. If any attempt at seizure be made, the instrument should be carefully warmed previous to introduction.

Difficulties arising from unusual sensitiveness of the uvula and soft palate may generally be overcome by patience and dexterity on the part of the surgeon, and a little practice on the part of the patient. During the earlier attempts the speculum should not be maintained too long in contact with the parts. It should be at once withdrawn if decided retching is produced; and, short of such effect, if the irritability is great, it is better to apply the speculum repeatedly for a moment or two, and remove it as often, without caring to obtain any view until the parts have become as it were accustomed to the presence of the instrument. When once efforts at vomiting have been excited, there is little probability of success until a future occasion. The practitioner should remember that local congestion is often produced at the time, and might mislead unless he be on his guard. Preparatory measures of various kinds have been from time to time suggested; some of these are probably useful; others have been proved by experience to be altogether useless. Many owe their accredited efficacy to the confidence with which their exhibition has inspired the patient. The internal administration of bromide of ammonium or bromide of potassium in full doses has been strongly recommended and extensively tried, but with variable results. Gargles containing bromide of ammonium are said by Gibb to produce 'moderate anæsthesia' of the fauces in twenty-four hours.[1] Türck reports favourably of the repeated application to the fauces of a mixture (recommended by Bernatzik) which consists of three grains of hydrochlorate of morphia, one drachm of alcohol, and half an ounce of chloroform.[2] But all such applications as this would appear more likely to inflame than to soothe the sensitive parts. Alum gargles, or solutions of alum or some other astringent in the form of spray, are often useful. Occasionally a few whiffs of chloroform may be advantageously inhaled. But by far the best and easiest plan, so far as I know, is to direct the patient to suck a little ice immediately before submitting his throat for examination. The result is generally satisfactory.

Besides the various sources of difficulty thus discussed, there are others which depend upon inexperience and want of dexterity on the part of the surgeon. These can only be obviated by careful practice. The surgeon should not only familiarise himself with the management of the laryngoscope, but also with the relations and appearances presented by the healthy living parts when viewed by its aid. In colour especially, the mucous membrane of the larynx seen during life in the laryngeal mirror looks very different to what it does when examined after death on the *post-mortem* table. It is very possible for the tyro in laryngoscopy to mistake the natural tint of some parts for a certain degree of inflammatory redness.

The general appearances and relations of parts as seen in the laryngeal speculum need no special description. They may be learnt by the careful study of a larynx removed from the body, or by *auto-laryngoscopy*, or by the examination of the larynx of some living subject. But with regard to the colour presented by the different parts in a state of health, the following observations may be made.

The lingual surface of the epiglottis appears of a yellowish or pinkish drab colour. Its upper border is decidedly yellow. Its laryngeal surface, especially the 'cushion,' varies from a pinkish yellow to a deep pink; sometimes it appears bright red—so bright, indeed, as to suggest the idea of the existence of an inflammatory condition. The aryteno-epiglottidean folds are pale pink. Stoerk accurately describes them as being about the same colour as the gums. The mucous membrane covering the arytenoid cartilages is still pink, but of a somewhat deeper tint. The false vocal

epiglottis was elevated by means of a pair of flat-bladed forceps, and the growth was successfully removed. See *Die erste Ausrottung eines Polypen in der Kehlkopfshohle.* Dr. Bruns. Tübingen, 1862. Also *Die Laryngoskopie.* Dr. Bruns. Tübingen, 1865, p. 257.

[1] *The Laryngoscope in Throat Diseases, op. cit.* p. 46.

[2] *Allgem. Wiener Med. Zeit.* p. 98. 1863.

cords are perhaps slightly deeper pink still. The true vocal cords are distinguished by their glistening pearly whiteness; but sometimes they are slightly greyish. The cricoid cartilage is recognised by its well-marked yellowness. The tracheal cartilages appear of a yellowish drab colour; and between them the mucous membrane is pale pink.

A great variety of different instruments have been devised from time to time for the several purposes of demonstrating to others the appearances of the larynx under examination; of holding the laryngeal mirror in a position so as to leave both hands of the surgeon free; and of depressing the tongue at the same time the laryngeal mirror is introduced. Some of these are useful; others are rendered unnecessary by the aid of a skilful assistant. For descriptions of all such contrivances reference may be made to the special treatises already quoted.

General Remarks on the Treatment of Diseases of the Larynx.

The laryngoscope affords most valuable aid, not only in the diagnosis, but also in the treatment, of the various diseases of the larynx. Guided by the view obtained, the surgeon is enabled to make such local applications as may seem desirable, with accuracy and precision, and to perform many different operations—such as scarifying the mucous membrane, opening abscesses, removing growths, &c., with certainty and safety. The use of the laryngoscope has altogether set at rest the doubts formerly entertained as to the practicability of introducing brushes, probangs, and other instruments into the larynx.[1] Such doubts in the past time unquestionably prevented the adoption of methods of treatment that, in many cases, might have been eminently successful. But now-a-days it would appear that the danger is in the opposite direction, and that the tendency is rather to carry out local treatment too vigorously, or to rely upon it too exclusively.

Remedial applications may be made to particular parts, or to the whole of the interior of the larynx, with variable advantage by several different methods. It appears desirable to give at once a general description of such methods, and to refer in the succeeding sections to the special modifications requisite in the treatment of each particular malady.

Solid substances may be applied either in the mass or in powder. If applied in the mass, some form of caustic holder is requisite. No instrument answers so well, and at the same time is so safe, as a piece of moderately thick aluminium or silver wire mounted in a slender handle, and hollowed into a tiny cup, or roughened at the extremity. The roughened extremity may be dipped into various substances, as nitrate of silver, chloride of zinc, &c., while in a state of fusion; and a sufficient quantity may be taken up in a bead-like form, or as a thin coating. The wire may be easily bent at any angle requisite, and there is no danger of any considerable portion of the substance breaking off and falling upon parts it was not intended to reach. Such danger might arise during the use of some of the various complicated caustic holders that have been devised for similar purposes. By aid of the laryngoscope a small caustic bead, prepared in the manner described, may be definitely applied to any particular point; or if the wire is coated to a sufficient extent, the general surface may be wiped over.

Powders can only be applied to the mucous membrane generally. They may be inhaled through a tube, as recommended by Fournié, or, far better, blown in by means of Rauchfuss's insufflator,[2] or some modification of it. The insufflator, duly charged, is introduced into the back of the fauces, with the extremity turned down towards the larynx. The patient is then directed to make a slow, steady inspiration, and while he is doing so the india-rubber ball of the insufflator is suddenly compressed. In this instrument, however, the sudden pressure of the thumb is apt to alter its direction, and the application is not always certain. The tube insufflator is prefer-

[1] See edition of this Work, 1862, vol. iii. pp. 246 and 247, note.

[2] This instrument is figured in the essay on Diseases of the Nose, p. 645.

able, by means of which the operator blows the powder into the larynx. Under such circumstances, it is obvious that a considerable portion of the powder must be diffused over the mucous membrane of the larynx. The powders that have been used with most advantage in this matter are tannic acid, alum, acetate of lead, carbonate of bismuth, iodoform, and morphia ($\frac{1}{16}$ to $\frac{1}{2}$ gr.), and in some exceptional instances, nitrate of silver. It is scarcely needful to add that in every case the substance used should be very finely pulverised. Sometimes it may be advantageously diluted, or its bulk increased with two or three or more parts of sugar of milk, gum, or, better still, starch.[1]

Liquids, or substances in solution, may either be applied by means of a full-bellied camel's-hair brush (cut square or pointed), or small sponge, mounted on a properly curved aluminium or silver wire, or whalebone stem; or they may be injected in a fine shower from Gibb's 'laryngeal syringe,' or 'hand atomiser';[2] or they may be inhaled in the form of 'spray,' produced by one or other of the various instruments devised for the purpose. Strong solutions, especially those of a more or less caustic nature, should, as a rule, be applied by the brush. Among the more generally useful of such pigments may be enumerated those of nitrate of silver (℈ij. or ʒij. to ʒj. of distilled water), perchloride of iron (ʒj. or more of the liquor to ʒj.), pure carbolic acid (ʒss. or more to ʒj.), alum (a saturated or weaker solution), sulphate of copper (a saturated or weaker solution), &c. Glycerine or honey may be advantageously mixed with these solutions in considerable proportion, in order to give them viscidity, and render them more adhesive. Iodine (gr. xx.), iodide of potassium (gr. v.), and olive oil (ʒj.), form an application recommended by Dr. Marcet.[3] The 'glycerinum acidi tannici' (B. P.) may also be used in some cases. By means of the brush, all such substances may be applied with a certain degree of precision to any particular part. In some instances even nitric acid, chromic acid, and other powerful escharotics have been thus applied to ulcers, warty growths, &c., with safety and advantage. At the moment the brush is to be introduced into the larynx, the patient should be directed to make a full deep inspiration in order to dilate the aperture as widely as possible. In cases in which the epiglottis is pendent, it is often very difficult to get the brush beyond it into the larynx. Under such circumstances the laryngeal syringe may be more successfully used, inasmuch as its extremity may be guided round, and made to raise the pendent valve to a sufficient extent.

The inhalation of 'atomised fluids,' or spray, in the treatment of diseases of the air-passages, though suggested long previously, was first shown to be generally practicable by Sales-Giron in the year 1858.[4] Since then the great value of this method has been fully established, and various improvements have been from time to time effected in the apparatus employed.[5] The 'spray-producers' at present in ordinary use consist of two tubes (Bergson's tubes) fixed at right angles to one another; of these, one, placed horizontally, is connected at its distal extremity with some apparatus, by means of which a strong current of air or steam can be continuously projected through it; and the other, placed vertically, dips into a bottle or other small vessel containing the medicated fluid. The proximal extremity of each tube is terminated by a very fine orifice; and the orifice of the former tube is immediately over that of the latter. When a current of air or steam is made to rush forcibly from the orifice of the one tube over that of the other, it causes the

[1] Studley, *American Medical Times*, March 2, 1861.

[2] See *The Laryngoscope in Diseases of the Throat*, by Sir G. D. Gibb, M.D., *op. cit.* p. 92.

[3] *On Diseases of the Larynx*, by W. Marcet, M.D., p. 18. 1869.

[4] See the elaborate Report by Poggiale read before the Académie de Médecine, Paris, January 7, 1863, and the discussion thereon. Also Dr. Beigel's treatise *On Inhalation*, London, 1866, in which are full details as to the history of this method of treatment, and descriptions of the different forms of apparatus devised.

[5] Mackenzie especially recommends Mayer's modification of Matthieu's apparatus, which is worked by means of a pressure-pump, and acts on a different principle to that described above. The fluid is forced through a fine orifice and projected against the interior of a vulcanite 'drum.' It thus becomes broken up into a fine spray. *Op. cit.* p. 90.

medicated fluid to rise, and breaks it up as it issues, and diffuses it in an exquisitely fine spray. In Dr. Andrew Clark's well-known instrument (as well as in the various modifications of it adopted by different makers), air is employed, and the current is kept up by means of an india-rubber 'handball' bellows. All such instruments, however, though unquestionably useful, are far inferior, for several obvious reasons, to those in which a jet of steam is employed, as first suggested by Dr. Siegel of Stuttgart. The steam is derived from water contained in a small boiler heated by a spirit-lamp. Figs. 149 and 150 represent two very efficient modifications of Dr. Siegel's original pattern.[1]

The use of this instrument involves no continuous exertion like the handball spray-producers: and what is of far more importance, the atomised fluid is mixed with and propelled by a current of warm steam instead of cold air. Dr. Solis Cohen's single-ball spray-producer is a valuable instrument. Dr. Mackenzie has pointed out that there is no advantage in having a continuous spray for the throat, as the spray cannot be continuously inhaled. Where dyspnœa exists, a strong current of air or steam is to be avoided. A great variety of different solutions, the strength being varied according to circumstances, may be advantageously inhaled in the form of spray. Among them may be especially mentioned the following—the

Fig. 150.—Siegel's Steam Spray-producer on stand, with Beigel's Face-screen attached.

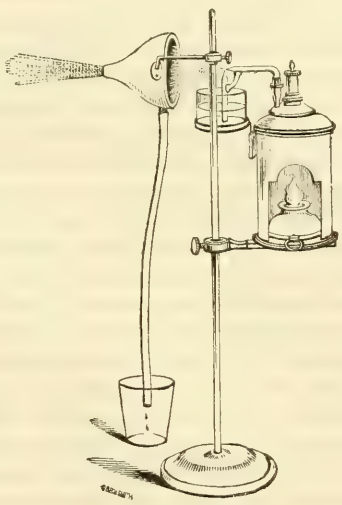
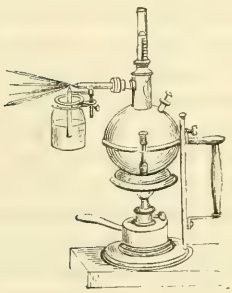


Fig. 149.—Simple form of Siegel's Steam Spray-producer.



medicament being in each case in about the proportions specified to an ounce of water: —Alum (gr. x. to gr. xx.), tannic acid (gr. i. to gr. xx.), perchloride of iron (gr. $\frac{1}{8}$ to gr. ij., or of the liquor ʒj. to ʒij.), as 'astringents;' common salt or chloride of ammonium (gr. x. to gr. xxx.), chlorate of potash, borax, or iodide of potassium (gr. iij. to gr. x.), as 'alteratives;' and watery extract of opium (gr. $\frac{1}{4}$ to gr. $\frac{1}{2}$), hydrochlorate of morphia (gr. $\frac{1}{8}$ to gr. $\frac{1}{3}$), or fluid extract of hemlock or hyoscyamus (♏iij. to ♏x.), as 'sedatives' or 'anodynes.' Very weak watery solutions of iodine, and chlorine (or chlorinated soda), tar water, lime water, weak alkaline solutions, sea water, the saline waters of many mineral springs,[2] and other solutions too numerous to mention have also been largely used in different cases with variable

[1] These as well as other forms of this apparatus are made by Messrs. Krohne and Sesemann.

[2] 'In 1849 Auphan, of Euzet-les-Bains, originated the idea of atomising the mineral water by throwing a jet of the liquid against the wall of the inhalatory. After a short time the same system was adopted in Lamotte-les-Bains. But Sales-Giron first constructed at Pierrefonds an apparatus through which the fluid was subdivided into a fine mist, which was inhaled by the patients with great benefit.'—Beigel, *op. cit.* p. 6. At many of the Continental Spas arrangements are now made for the inhalation of the 'atomised' waters.

advantage. Sulphurous acid in spray has been very strongly recommended in the treatment of various affections of the throat and larynx by Dr. Dewar and others. But experience seems to show that great caution is requisite in the use of this material. Though doubtless beneficial in some cases, in many it has proved not only less efficacious, but far more mischievous than was anticipated. Solutions of nitrate of silver and other powerful metallic salts are unsuitable for application by means of the spray-producer.

Many substances may be inhaled with very great advantage in the form of vapour or gas. In various acute or sub-acute affections nothing is more soothing and beneficial than the almost constant inhalation of warm steam, either plain or charged with some narcotic or anodyne element. The 'hemlock inhalation' of the British Pharmacopœia is very useful; it is rendered less disagreeable and perhaps more efficacious by the addition of a pinch or two of fresh dried hops; or the hops may be infused alone in the hot water; or a portion of opium may be added; in some cases vinegar is useful and pleasant. In chronic cases, according to their nature, the vapour of turpentine, or some aromatic terebinthinate, as pine oil or iodine, or calomel, may be inhaled with very great benefit. For the inhalation of steam, plain or medicated, various so-called 'inhalers' have been devised. Among those ordinarily used may be mentioned Nelson's, Maw's 'double-valved inhaler,' Mudge's, and Beigel's made by Robbins. The two first named are furnished with pieces of sponge which are intended to be inbued with the medicament to be used; but practically it is far better to remove the sponges and to mix the medicament with the hot water. The two last inhalers involve somewhat more respiratory exertion on the part of the patient. But they have the advantage of acting on the 'hookah' principle; the air to be inspired passes through the fluid, and thus becomes thoroughly warmed and charged with vapour. But by far the most perfect inhaler yet devised is that made by Messrs. Maw under the direction of Dr. Mackenzie, and by him termed the 'Electric Inhaler.' The advantages of this apparatus are so obvious that it will probably to a great extent supersede those hitherto in use. Bird's inhaling pipe is worthy of mention, as likely to prove very useful for the exhibition of certain vapours, &c.[1]

Scarification of the mucous membrane of the larynx may be practised with considerable advantage in many cases. The instruments requisite and the method of operating have been already described in the first volume of this work.[2]

In all cases, if practicable, the instrument (which must be very sharp) should be guided by the aid of the laryngoscope. Mackenzie's laryngeal lancet answers the purpose admirably; but it is somewhat complicated, and is not so likely to be at hand as the simple instruments recommended. Numerous punctures or short cuts may be made, if requisite, in different parts. There is very rarely much bleeding, and never, so far as I know, any more than is actually beneficial.

The direct galvanisation of the vocal cords is undoubtedly of value in many nervo-muscular affections of the larynx. The most efficient instruments for this purpose are the laryngeal electrodes and necklet of Mackenzie.[3] They are so constructed that the current does not pass till the metal point or sponge is in contact with the vocal cords. The instrument is held in the hand between the thumb and *second* finger, and when the sponge has been placed in the desired position, the operator with his index-finger presses on the key in the handle, and the electric current passes through the larynx to the skin externally. At the same time the patient wears a necklet communicating with the other wire of the battery. The galvaniser may be applied several times at the same sitting, it being kept in for a few seconds each time, and he should be directed to count one, two, three, &c., at the moment the current is made to pass. Dr. Fauvet has so modified this instrument by uniting the two poles, in the same handle, that pressure on the key permits the current to pass between the two knobs. This arrangement limits the current—a great advantage where it is desired to galvanise a single muscle.

[1] Made by Maw. See *Med. Times and Gaz.* vol. i., 1869, p. 672.
[2] See essay on INJURIES OF THE NECK.
[3] See Mackenzie, *Diseases of Throat and Nose*, vol. i. p. 253.

Catarrhal Laryngitis.

Acute catarrhal laryngitis is not a very rare affection. It varies greatly in intensity, and consequently in the degree of danger to which it gives rise. It may occur at almost any period of life, but is most frequently met with in adults of plethoric habits.

Exposure to cold and damp, especially after prolonged exertion of the voice, or when the general powers are reduced by fatigue, or by disease such as typhoid fever, measles, small-pox, diphtheria, &c., especially when the throat has been implicated, are the most common causes. It is common, too, after chronic laryngitis following syphilis or tuberculosis.

As a rule the fauces are first affected, and the inflammation spreads with variable rapidity to the larynx. Sometimes, however, the malady commences in the larynx itself, and is confined to it, or it may implicate the trachea.

The earliest *symptoms* are those of an ordinary 'sore-throat.' The patient complains of dryness, soreness, and a sense of constriction about the upper part of the throat, and occasionally pain and difficulty in swallowing. The feeling of discomfort is constantly referred to the pomum Adami, or its immediate neighbourhood. Respiration is rarely impeded. The patient's voice becomes thick and husky; and occasionally he tries as it were 'to clear his throat' by a dry, harsh, or half suppressed cough; often the voice is altogether lost.

In some cases the symptoms increase in severity; and the patient becomes restless and anxious. The face is flushed, the skin hot and dry, the pulse hard and quick. Respiration becomes more and more seriously impeded. Inspiration is difficult, protracted, and painful, and is accompanied by a wheezing, whistling, or harsh throttling sound. The chest is not fully expanded; and there is diminution of the respiratory murmur. Expiration remains comparatively easy; for the warm, moist air from the lungs irritates the inflamed and sensitive mucous membrane much less than the colder, drier air, inspired from without. The dyspnœa is constant in so far as it depends upon constriction of the glottis from swelling of the mucous membrane; but it becomes greatly aggravated at intervals in consequence of spasmodic action of the muscles. The voice, at first husky and hoarse, soon becomes low in tone, or 'cracked' and uncertain, and finally is altogether lost, the patient speaking only in a whisper. In some cases there is but little cough. In others the cough is frequent, and harsh, husky, or stridulous in character. Cough may be provoked either during inspiration by the contact of cold dry air, or during expiration by the presence of little masses of secretion. The sputa in the earliest stages are very scanty, and consist of little more than saliva; later they become somewhat more abundant, but are still semi-translucent, though more or less tenacious and viscid, containing laryngeal mucus as well as saliva; still later they are opaque and greyish, and sometimes are slightly streaked with blood. After any of these have been coughed up a painful sense of rawness about the part is often experienced. The small, firm, agglutinated masses which are occasionally coughed up, probably come, according to Krishaber, from the ventricles of Morgagni. The difficulty of swallowing, almost invariably noticed as one of the earliest symptoms, in these severe cases becomes more and more pronounced as the malady progresses. '*Difficulty of deglutition* for which no adequate cause is visible in the fauces,' speedily followed by '*difficulty of breathing* for which no adequate cause can be discovered in the thorax,' are, in the words of Sir Thomas Watson, 'among the earliest of the symptoms that bespeak danger, and ought to excite alarm.'[1]

If the malady advances to the next stage, and no relief is afforded, the general distress of the patient becomes intense. He labours and struggles for breath. His anxiety and restlessness are extreme. He cannot lie down; or, if exhausted, he tries to do so, he soon starts up involuntarily, gasping for very life. His countenance becomes pale and livid, or even ghastly; his eyes protrude; sweat pours from his forehead; his skin is cold and clammy; his pulse becomes weak and intermittent; exhaustion, drowsiness, and perhaps delirium supervene; and lastly, he dies suffocated

[1] *Lectures on the Principles and Practice of Medicine*, 5th edit. 1871, vol. i. p. 865.

either almost suddenly from spasm of the larynx, or by a process of comparatively slow asphyxiation. The morbid changes which give rise to the symptoms thus described may be traced during life by aid of the laryngoscope, or made out after death on post-mortem examination.

On *laryngoscopical inspection* the mucous membrane of the larynx is seen to be of an unnatural scarlet red colour, and more or less thickened or swollen, from serous or sero-fibrinous effusion into the areolar tissue. Occasionally superficial erosions may be recognised here and there; but neither deep nor extensive ulceration is observed, or only extremely rarely. The redness and swelling, as a rule, are especially manifest in those parts in which the mucous membrane is thick, and is supported by abundant loose submucous areolar tissue. Thus the aryteno-epiglottidean folds, the mucous membrane of the vestibule, the false vocal cords, and the laryngeal aspect of the epiglottis present these appearances in the most marked degree; and, generally speaking, they are affected in extent in the order in which they are named. The mucous membrane of the true vocal cords, on the other hand, being comparatively thin, and closely connected with dense subjacent tissues, is less swollen, and less uniformly reddened. Sometimes it is marked by red striæ or patches. Sometimes it seems only to have lost its pearly whiteness, and to have become dull, clouded, or pinkish in colour, and somewhat unduly protuberant. But, as may readily be understood, in many cases the true vocal cords are almost or entirely concealed from view by the swollen parts above. Still more is this the case with the parts of the larynx below the glottis and the trachea, which, nevertheless, not infrequently suffer from extension of the inflammation. The epiglottis is usually seen to be erect, rigid, and swollen. It is consequently unfitted to fulfil its natural valvular office. Sometimes it may be felt by the fingers as a smooth rounded, 'cherry-like' intumescence. Occasionally it gives rise to sensations similar to those produced by the presence of a foreign body. The patient 'feels as though he had something in his throat.'

The condition of the epiglottis serves in great measure to explain the difficulty in swallowing, and the sense of suffocation often experienced when the attempt is made. The dysphagia is still further accounted for by the pain caused by the necessary movement of the inflamed and unduly sensitive parts.

The swollen condition of the mucous membrane and consequent constriction of the glottis manifestly give rise to the constant difficulty of breathing, and this as a rule is much more marked in children on account of the small area of the opening of the glottis, and also to spasm, which in them is much more easily induced. The temporary paroxysms of extreme dyspnœa are probably caused by muscular spasm incidentally or accidentally excited.

Post-mortem examination shows that the swelling depends upon an injected, infiltrated, and œdematous condition of the mucous membrane and submucous tissue. The redness of the parts observed during life is often partially or wholly lost—inasmuch as the mucous membrane shares in the general pallor of death. Soft, semi-purulent, or viscous exudation is usually found covering to some extent the membrane. In some cases the trachea and bronchi are also affected; and the lungs are congested, or even pneumonic.

The *diagnosis* of acute catarrhal laryngitis is not difficult. It may be distinguished from croup and diphtheria by the absence of the false membranes and fibrinous exudations which characterise these maladies; and from croup especially by the difficulty in swallowing and the early alteration or extinction of the voice. In croup swallowing is usually easy; the voice is often but little affected; the breathing is 'stridulous,' and the cough has a peculiar ringing 'brassy' sound.[1]

Laryngitis may be distinguished from the first effects of a foreign body in the air-passages by the sudden severity with which in the latter case the dyspnœa comes on, the periods of intermission which occur, and the absence of premonitory febrile disturbance. The difficulty of breathing caused by the presence of a foreign body is usually most marked during expiration. The reverse is the case in laryngitis.[2]

[1] See the article on CROUP AND DIPHTHERIA.

[2] See chapter on 'Foreign Bodies in the Air Passages,' essay INJURIES OF THE NECK, vol. i.

In cynanche tonsillaris respiration is often obstructed. But the cause of obstruction is at once manifest on inspecting the fauces. In laryngitis, on the other hand, the amount of swelling in the upper part of the throat, if even any exists, is altogether insufficient to account for the extreme difficulty of breathing and swallowing, and the alteration or extinction of the voice. It must be borne in mind, however, that laryngitis, or at any rate œdema of the larynx, may coexist with inflammation of the tonsils and mucous membrane of the fauces and pharynx.

In simple pharyngitis there is little or no dyspnœa; but swallowing is painful and difficult, and pain is felt when the larynx is pressed backwards.

The *course* of acute catarrhal laryngitis is usually rapid. Its duration depends upon the intensity of the inflammation, the constitution of the patient, and the nature and efficacy of the treatment adopted. In the worst cases, if unchecked, it often proves fatal on the fourth or fifth day, and sometimes much more speedily. The celebrated General Washington died of this disease within twenty-four hours. Sir Thomas Watson alludes to an instance in which a fatal result ensued in twelve hours.[1]

Mr. Gray mentions the case of a man who was 'admitted into St. George's Hospital complaining merely of a sore throat. He walked into the hospital, and seemed in such good health that he would not have been admitted, but for the circumstance of his having come some distance from the country. About three hours after his admission, the house surgeon was summoned in all haste to see him, as he was said to be dying of suffocation. He went immediately, but found the patient quite dead. Post-mortem examination revealed all the evidences of laryngitis, supervening apparently upon inflammation of the pharynx; but it was especially remarked, that the chink of the glottis was not much narrowed from œdema. In this case there can be no doubt that death was produced by spasmodic contraction of the muscles of the glottis.[2]

In some instances, however, the malady runs a less rapid course, and the patient survives until the eighth or ninth day. In others, and these happily the majority, the inflammation subsides either spontaneously, or as the result of treatment. In such case the effects may disappear almost altogether with comparative rapidity, or the malady may assume a chronic form.

Treatment.—The treatment requisite depends upon the severity of the malady, and the stage it may have reached. Measures which are urgently demanded in some cases are in others unnecessary, and even dangerous. And the mode of treatment that might be most efficacious at the onset of the malady, if adopted too late, may only hasten the fatal termination.

In the earlier stages, and in cases in which the symptoms are comparatively mild, perfect quiet in a warm moist atmosphere, soothing inhalations either of simple or medicated steam or spray, and the administration of salines, with perhaps antimonials and tincture of aconite or some sedative, according to circumstances, constitute the treatment requisite; astringent sprays of alum or sulphate of zinc (two to five grains to the ounce) are usually very beneficial; entire rest of the larynx is imperative. But in all cases careful watching is necessary; for dangerous symptoms may supervene at any time, and even almost suddenly.

In the more severe forms of the malady, similar but more energetic measures must be rigorously enforced. Soothing inhalations may still be advantageously employed, but their use must be more constant. Antimony and tincture of aconite in small but frequently repeated doses should be administered, especially in cases in which there is much general inflammatory fever.[3] Free mercurialisation combined with opium or hyoscyamus has been strongly advocated, especially by the German surgeons, but its efficacy appears doubtful; and much precious time may be lost before the system can be affected.

Local blood-letting by means of leeches to the neck or suprasternal notch, or cupping to the nape of the neck, may sometimes prove beneficial. So also may blisters

[1] *Op. cit.* vol. i. p. 867. [2] See first edition of this work, vol. iii. p. 226.

[3] The following formula may be recommended:—Vin. antim. tart. ℥ij. to ℥iij., tinct. aconiti ℥j to ℥ij., liq. ammon. acetat. ʒss.; to be taken in water or camphor julep every quarter of an hour or every half-hour, until some obvious effect on the circulation, &c. is produced, and then to be continued less frequently.

or milder counter-irritants; but these should not be applied immediately over the larynx.

When the mucous membrane is so swollen as to impede respiration and swallowing to a serious extent, scarification by means of a sharp-pointed guarded bistoury, or some specially designed instrument, is often followed by speedy relief.

A somewhat remarkable case illustrating the effects of this method of treatment came under Mr. Durham's observation in December 1866. 'A gentleman residing in Essex, fancying he heard poachers in the neighbourhood, got up in the middle of the night, went out carelessly dressed, and concealed himself for two or three hours in a ditch. The next morning he was seized with all the symptoms of intense laryngitis; and he died suffocated within eighteen hours. Three days afterwards the brother of this gentleman, depressed in spirits, and fatigued and almost exhausted, was exposed for some time to cold and wet. In the evening he was attacked by symptoms similar to those from which his brother had suffered. The next morning I saw him in consultation with his medical attendant, Mr. Jordison of South Ockenden. The soft palate, uvula, and pillars of the fauces were acutely inflamed, and very much swollen and œdematous. The epiglottis and aryteno-epiglottidean folds were in a similar condition. The patient's suffering was extreme; breathing was carried on with great difficulty; swallowing was impossible. I at once freely scarified the affected parts by a number of punctures and small incisions, and caused the patient to inhale the steam of hot water. A considerable quantity of serous or sero-purulent exudation with some blood was discharged. In the course of half an hour the breathing was much relieved, and swallowing was accomplished without any great difficulty. The swelling of the parts rapidly subsided, and the next day, when I saw him again, the patient could breathe and swallow with comparative ease—indeed, almost naturally—but he still suffered from considerable general distress, and symptoms of pericarditis were recognised. Death took place twelve hours after my visit, or about sixty hours from the commencement of the attack. Post-mortem examination revealed the most intense inflammation of the whole pericardium I have ever seen. But the extent to which the faucial and laryngeal mucous membranes had recovered their natural condition and appearance was very remarkable.'

Sir D. Gibb (following Dr. Horace Green) strongly advocates the application of a solution of nitrate of silver (three or four scruples to an ounce of water) in cases of acute laryngitis. The application may be made by means of a full-bellied camel's-hair brush on a curved aluminium wire stem, or by 'the laryngeal fluid pulveriser.' 'The effect of this proceeding is some considerable amount of burning heat, associated with comparatively little spasm, and sometimes dyspnœa, the last two persisting for may be a few seconds only. . . . The relief experienced, and the amelioration in the general symptoms, is observed in periods ranging from half an hour to four hours, and the dyspnœa subsides very speedily.'[1]

If, as sometimes happens, the malady advances in spite of all such measures as those above suggested, or if the difficulty of breathing is too urgent to admit of their adoption, tracheotomy must be at once performed. In no class of cases probably is the value of tracheotomy as a life-saving operation more obvious and more pronounced. No definite rule can be laid down as to the period at which it may be desirable to operate. The surgeon must decide in each case when the proper moment has arrived, and must not hesitate to urge in the strongest terms the importance of every minute. There is far greater danger in delaying the operation too long, than in performing it unnecessarily early. The operation itself, if properly performed, is attended by little or no risk.[2] But it affords immediate relief from the direst suffering. It obviates altogether the recurrence of those frightful paroxysms of dyspnœa, in any one of which the patient may die suffocated. It affords perfect repose to the suffering parts, and saves them from the irritation of the hard-drawn breath. It thus allows opportunity for the subsidence of inflammatory action, and the absorption of effused material. It may not *cure*, but if performed in time, it certainly ensures a period of safety and freedom from distress, during which the cure may be effected by natural processes. Further, in acute laryngitis the obstruction to respiration is, as a rule, confined to the larynx itself, and the parts below are rarely affected to any serious extent; the malady runs a rapid course, and under favourable circumstances subsides almost as quickly as it arises. Hence, not only is immediate

[1] *On Diseases of the Throat and Windpipe*, by G. D. Gibb, M.D., 2nd edition, p. 196.

[2] See an essay by Mr. A. E. Durham, 'On Some of the Difficulties and Dangers of Tracheotomy,' in the *Practitioner*, April 1869.

relief almost absolutely certain, but there is little probability that the cannula need be retained longer than a few days at the outside. While fully impressed with the danger of delay, the surgeon must nevertheless bear in mind that until the patient is actually dead it can never be too late to attempt the operation. And even if it should seem that the last breath has just been drawn, the operation should still be completed, and persevering efforts made to restore life by artificial respiration. Success has crowned such efforts in cases in which the general powers have not been too far exhausted by slow asphyxiation.

Chronic catarrhal laryngitis is sometimes the sequel of one or more attacks of acute or sub-acute inflammation. More often it occurs without being referable to any special cause.

Chronic catarrhal laryngitis is much more frequently met with among adult males than among females or children. This is due in great measure, no doubt, to the more constant exposure to vicissitudes of weather to which men are subject, as well as to the greater demands made upon their respiratory and vocal organs from the nature of their occupations. It often results in cases in which the acute symptoms have not been very severe; or in which they have subsided so far as to permit the patients to resume, without immediate inconvenience, their usual habits before the actual structural lesions have been sufficiently repaired. Hence the necessity for continued rest, watchfulness, and judicious treatment during convalescence from acute catarrhal laryngitis, even though the symptoms may have been comparatively mild. It need scarcely be remarked that when once the chronic affection is established, and so long as it continues, the patient is especially liable to a recurrence of acute attacks, any one of which may be fraught with danger.

The *symptoms* of chronic catarrhal laryngitis are:—hoarseness, want of tone, or some other unnatural condition of the voice; a sense of effort during speaking (especially if at all prolonged), and of fatigue afterwards; frequent desire 'to clear the throat;' and more or less frequent cough, accompanied by occasional but scanty expectoration of thick, greyish, opaque, or semi-purulent mucus. A general sense of discomfort is sometimes experienced, but there is no pain in the part; nor is there any marked tenderness on pressure. Tranquil respiration is, as a rule, performed easily, and without the characteristic whistling or throttling sound emitted during inspiration in acute laryngitis. Forced respiration, however, is sometimes accompanied by unnatural sounds, which may be readily heard by means of a stethoscope placed over the larynx or trachea. The cough is no longer 'tearing' and painful, nor harsh, ringing, and 'brassy' as in the acute stages; though often hoarse, and somewhat sonorous, it is not distressing, and suffocative paroxysms very rarely if ever occur. Deglutition is easy and painless.

Thus it would appear that there is nothing absolutely distinctive in the symptoms of chronic catarrhal laryngitis; for very similar symptoms are associated with other totally different conditions to be hereafter discussed. Nevertheless, it is very important that a correct diagnosis should be made, inasmuch as the treatment requisite, as well as the probable issue, may differ very materially from what would be indicated in at any rate some of the other affections alluded to.[1]

On *laryngoscopical inspection* the mucous membrane of the larynx is seen to be thickened and unnaturally red, and covered here and there by patches of greyish opaque mucus. The thickening and redness may be either more or less uniform, or irregular and much more pronounced in some parts than in others. In order of frequency the posterior aspect of the epiglottis, the aryteno-epiglottidean folds, the interarytenoid fold, the anterior aspect of the epiglottis, the false vocal cords, and the true vocal cords, are the parts usually affected. In general terms, the acute inflammatory attack is most frequently followed by chronic after-effects in those parts which are naturally most vascular, and most abundantly supplied with glandular structures.

[1] It is also necessary to bear in mind that in some cases the inflammation seems almost entirely confined to the region below the vocal cords. This sub-glottic variety is attended with danger, and is much more difficult to treat successfully.

Ulcers are very rarely seen, but sometimes small superficial cicatrix-like patches may be observed; and occasionally even a dilated blood-vessel or two may be noticed ramifying in the mucous membrane.

The alteration of the voice does not bear any definite relation to the extent to which the true vocal cords are affected. There may be considerable hoarseness, or partial or even complete loss of voice, in cases in which the vocal cords themselves are found on examination to be almost or altogether healthy in appearance. In such cases the explanation may be due either to the swollen condition of the neighbouring parts, which may mechanically prevent the due approximation and tension of the true vocal cords, or may deaden or modify the sound produced by their vibration; or it may be that the surrounding infiltration, or some other effect of the inflammatory process, may hamper or otherwise interfere with the necessary action of the muscles. Whatever may be the explanation in any particular case, laryngoscopy has amply proved (contrary to what was formerly supposed) that the voice may be more or less obviously altered in character, or impaired in power, although the true vocal cords retain their integrity and healthy appearance. The converse is also true. The vocal cords may be visibly affected to some extent in various different ways, as hereafter indicated, without any very serious detriment to the speaking, if not to the singing voice.

The *course and duration* of chronic catarrhal laryngitis vary greatly in different cases. Sometimes it subsides spontaneously in the course of two or three weeks or more. Sometimes, especially if neglected, it remains obstinately persistent; and more or less permanent thickening or hypertrophy (so called) of the mucous membrane results. As a general rule, however, it is amenable to treatment. In some cases of long standing warty growths become developed. In others tracheal, bronchial, or pulmonary complications arise. In all cases there is great liability to fresh attacks of acute or sub-acute inflammation.

Treatment.—The treatment most likely to prove successful in simple catarrhal laryngitis, which has become chronic in character, depends somewhat upon the stage the malady may have reached, and the severity of the symptoms. It rarely happens, however, that any other than local measures are requisite, or indeed beneficial, except in so far as they may tend to the improvement of the general health and strength. But in all cases it is desirable, and in some absolutely necessary, to insist upon the importance of affording to the suffering parts as much rest and as little excitement and irritation as may be practicable. All unnecessary exertions of the vocal and respiratory organs must for a time be avoided. In the subglottic forms of disease tracheotomy may be necessary, but hypertrophy should, if possible, be prevented, by the passage of the hollow vulcanite tubes devised by Schroetter of Vienna. In some cases scarification is found to be of great value.

In the earlier stages of the simple form, the warm soothing vapour inhalations, so beneficial during the period of acute inflammation, must be replaced by more or less frequently repeated applications of astringent solutions, either in the form of spray or by the brush. In a large proportion of cases the inhalation of the spray of weak solutions of alum, tannic acid, or perchloride of iron several times a day—or even of common salt, chloride of ammonium, or chlorate of potash—is all that is necessary. Sometimes, however—and indeed I believe in all cases according to some authorities—it is better to resort at once to the application of a strong solution of nitrate of silver (℥j. to ℥j. of water) by means of the brush, or sponge probang. Mackenzie recommends a solution of chloride of zinc (30 gr. to the ounce), and in long-standing cases with diminished secretion, half a drachm to a drachm of pure white carbolic acid to an ounce of glycerine.

In the more advanced stages, when the affection has become decidedly chronic in character, and all reasonable hope of spontaneous subsidence, or of improvement under milder treatment, has passed away, the efficiency of the application of the nitrate of silver solution is most marked. The whole surface of the interior of the larynx may be wiped round with the brush; or by aid of the laryngoscope the application may be limited to those parts only which are especially affected. If the sponge

is used, as originally recommended by Dr. Horace Green, precision of application is of course impossible; but the spasmodic contraction excited may serve to squeeze from the sponge a considerable quantity of the solution, which may become diffused over the whole surface. But, as before stated, the brush is far preferable to the sponge. The application is easily made in accordance with the directions already given.

The spasmodic distress, sometimes though not always produced, very speedily subsides. It is well, however, to direct the patient to hold his breath immediately after the application for a few seconds. The good effects are almost immediately perceptible, but are by no means transient. In some cases the application seems to act almost like a charm; and the voice, which before was painfully hoarse, is rendered at once comparatively natural in tone. The application should be repeated once daily, on alternate days, or less often, according to circumstances, until the cure is complete. At intervals between the applications frequent inhalations of the spray of solutions of common salt, chloride of ammonium, or alum may be recommended. Small blisters may sometimes be advantageously applied over the larynx; or counter-irritation may be kept up by means of the strong tincture of iodine, or the iodine liniment.

In cases of very long standing, and especially in those in which the tracheal and bronchial mucous membranes are also affected by chronic catarrhal inflammation, inhalations of balsamic and terebinthinate vapours often prove very beneficial. Turpentine, tar, the balsams of Tolu, Peru, and Canada, or their alcoholic solutions, gum benzoin or benzoic acid, and other similar substances, may be mixed (singly or in combination) with hot water in an appropriate vessel, and the vapour may be inhaled from time to time. Dr. Symonds recommends that substances of this kind should be mixed with æther or pyro-acetic spirit in a wide-mouthed bottle from which the inhalation may be made.[1] Another method consists in keeping the atmosphere of the room in which the patient may be constantly impregnated with the remedial vapours, either by heating portions of the balsamic substances over a spirit-lamp, or by putting them upon hot coals. This method is especially recommended by Trousseau and Pidoux, who state that by its persevering adoption cases of chronic laryngitis have been cured which had not been benefited by interrupted inhalations.[2] The same authors also refer to the good effects sometimes produced by the empyreumatic oil of burning paper ('l'huile de papier'), and recommend the inhalation of the smoke of cigarettes of paper, either plain or imbued with some arsenical or other medicinal solution.[3]

Tar water may be inhaled in the form of spray; so also may weak solutions of chloride of zinc, nitrate of silver, &c. But these saline solutions appear to be less efficacious in cases of the class now under discussion than in those which are more recent, and in which the morbid condition of the mucous membrane is less extensive, and less confirmed in character.

Internal remedies sometimes prove useful, especially such as are indicated in catarrhal affections of the respiratory mucous membranes generally, as, for example, decoction of senega with ammonia, the various balsams, chloride of ammonium with tonics, &c.

Men who are subject to catarrhal and other chronic affections of the larynx should wear their beards; and women should be advised to take due precaution for the protection of their necks, especially when they are exposed to cold or vicissitudes of temperature.

[1] The following formulæ are given:—Æther ʒj., benzoic acid ʒiv., Peruvian balsam ʒij.; mix. 2. Pyro-acetic spirit ʒss., æther ʒss., benzoic acid ʒiv., balsam of Peru ʒij.; mix. 3. Æther ʒss., spirits of turpentine ʒss., benzoic acid ʒiv., balsam of Tolu ʒij.; mix. 4. Æther ʒvi., pyro-acetic acid ʒij.; mix. The warmth of the hand is sufficient for volatilising these mixtures.—'Therapeutical Memoranda,' by J. A. Symonds, M.D., *British Medical Journal*, May 1868, p. 448.

[2] *Traité de Thérapeutique*, par Trousseau et Pidoux. Vol. ii. p. 840. Paris, 1869. *Ibid.* vol. i. p. 172.

Chronic Glandular Laryngitis. Follicular Disease of the Larynx. Dysphonia Clericorum.

Chronic glandular laryngitis is a comparatively common affection.[1] It is most frequently, but by no means solely, met with among those who are subject from time to time to continuous exertion of the voice, as clergymen, barristers, singers, and others. It essentially consists in more or less general enlargement and hypertrophy of the glandules and follicles of the laryngeal mucous membrane, the result of an inflammatory condition which usually commences very insidiously, and always progresses very slowly. It is often, but not invariably, associated with a similar affection of the faucial, naso-pharyngeal, and pharyngeal mucous membranes.

The most frequent cause probably is, as already indicated, continuous exertion of the voice. It is obvious that in prolonged speaking, reading, or singing, the demands made upon the vocal organs are not only greater than during ordinary conversation, but also in some degree different. In ordinary conversation the parts are subject to no great strain; and more or less frequent intervals of rest are afforded, during which the mucous membrane can recover its normal condition. But in the continuous and strong exertion of the voice constantly made by public speakers and singers, the mucous membrane is specially liable to become irritated by the forcible contact, and rapid passage over it, of cold dry air drawn in at each inspiration through the mouth, and not warmed and moistened by passing through the nasal fossæ. To allay the irritation and mitigate the dryness thus produced, the mucous follicles are stimulated to increased activity, and for a time are able to secrete a sufficient quantity of mucus for the lubrication of the surface. Ultimately they are liable to become inflamed and hypertrophied. Further, it is worthy of note that the mucous membrane covering the arytenoid cartilages, and immediately adjoining parts, is more rich in glandular structures than any other portion of the laryngeal mucous membrane. Now this part is constantly subject to a very great extent of motion, and also, perhaps, to considerable strain, during forced vocalisation. And thus its glands are specially liable to be stimulated to increased activity; and the morbid condition under discussion may eventuate.

It is important to bear in mind, however, that chronic glandular laryngitis may, and indeed often does, occur in persons who have not been subject to any such continuous vocal exertions as those above referred to. In such cases exposure to cold and fog (especially if there is any obstruction of the nose), and the constant inspiration of air charged with irritating fumes or particles, appear to be the most frequent causes. Gibb states that he has seen this malady 'in a very exaggerated form in photographers, and in persons much exposed to the fumes of acrid chemicals in confined chambers, and its obstinacy in them is something quite remarkable.'[2] It is possible also that some constitutional tendency may favour the development of the malady. Indeed, Trousseau, Chomel, De Mussy, and others attribute its origin to the 'herpetic diathesis.'

The *symptoms* are :—alteration of the voice, and sense of effort in sustaining it—these are by far the most prominent and constant symptoms; more or less discomfort about the larynx, never amounting to pain, but occasionally troublesome; dryness, and sometimes a sense of heat about the throat; and constant desire to clear the throat by 'hemming' and 'hawking.' There is little or no regular cough; and the expectoration which sometimes occurs is slight, scanty, and mixed with saliva. There is neither difficulty in swallowing, nor tenderness upon pressure over the larynx. There are no definite constitutional symptoms: but the general health and spirits of the patient are often observed to be more or less depressed.

[1] This affection appears to have been accurately and fully described by Dr. Horace Green of New York, to whom also is due the credit of having especially taught and insisted upon the proper method of treating this and other affections of the larynx by the topical application of solutions of nitrate of silver, &c. See *A Treatise on Diseases of the Air-Passages*, by Horace Green, M.D. New York, 1846.

[2] *On Diseases of the Throat, op. cit.* p. 2.

The alteration in the voice depends upon the swollen condition of the arytenoid mucous membrane, which prevents the free movement of the cartilages, and thereby the necessary approximation of the vocal cords. The character of the voice varies somewhat. In the earlier stages it is simply wanting in clearness and tone and general reliability. In the later stages it becomes disagreeably harsh, husky, and hoarse. Sometimes it fails altogether, and the patient speaks in a husky whisper. As a general rule, the alteration in the voice is most pronounced in the early morning, before the vocal organs have been at all exercised, and again in the evening, or after any considerable exertion of the voice, when the parts have become fatigued. Sometimes the patient will feel that he is able to carry on ordinary conversation with ease; but directly he begins to read or speak continuously in a loud voice, he finds it impossible to proceed; or he only does so with great difficulty, sense of effort, and subsequent fatigue.

On inspection, the mucous membrane of the fauces and back of the throat is usually seen to present a more or less raw and irregularly granulated appearance; and the enlarged glandules, each (it may be) surrounded by a little halo of undue redness, may be recognised studding the surface. *Laryngoscopical examination* shows that the mucous membrane of the larynx is similarly affected; and in some cases, as already indicated, the malady is confined to the larynx. The parts most frequently and most obviously affected are, as might be expected, those in which the glandules are most abundant. These parts are the mucous membrane covering the arytenoid cartilages, the inter-arytenoid folds, the base of the epiglottis, and the ventricles and sacculi of the larynx. In cases of long standing, points of ulceration may sometimes be observed, especially about the base of the epiglottis. In others, the glandules appear to be not simply enlarged, but distended with opaque yellowish material.

The mucous membrane covering the vocal cords is very thin, and contains very few if any glandules. It is very rarely, therefore, observed to be affected in this malady. It occasionally presents, however, isolated granulations which might possibly be mistaken for enlarged glandules. Such a condition is described by Türck under the name of *Chorditis tuberosa*.[1]

The *course* of chronic glandular laryngitis is very tedious, and its *duration* very long, often extending over months or even years. It is not readily amenable to treatment; but by perseverance much good may generally be effected. Certain forms of new growth occasionally met with in the larynx may not improbably owe their origin to the localisation of this or some allied affection of the mucous glandules.

Treatment.—The method of treatment, which experience has shown to be the most effectual, consists in the application by the brush of solutions of nitrate of silver, or perchloride of iron, at intervals varied in frequency according to circumstances. The nitrate of silver, I believe, is, as a rule, the best application. Sulphate of zinc, sulphate of copper, and tincture of iodine [2] have also been recommended, and indeed it may be stated that it is often well to vary the application. That which answers perfectly in one case, or at one period, proves less efficacious in others, or at other periods, and under changed conditions in the course of the same case. Any points of ulceration that may be seen should be touched by means of the probe with solid nitrate of silver. Between such applications spray should be inhaled at frequent intervals during the day. The best solutions for the purpose are those of common salt, chloride of ammonium, iodide of potassium, and in some cases alum, or weak solutions of perchloride of iron. Certain mineral waters, especially such as contain the sulphides of sodium or calcium, have also been strongly recommended, as well as artificial solutions of sulphurous acid.

A method of treatment, which appears to be especially useful in this form of laryngeal disease, consists in slowly sucking medicated lozenges. The precise and careful observations of Fournié [3] prove (contrary, perhaps, to what might be expected) that certain portions of liquid swallowed, especially if swallowed slowly, or allowed

[1] See *op. cit.* p. 164.

[2] Iodine, 1 part; iodide of potassium, 3 parts; distilled water, 18 parts. (Krishaber.)

[3] *Etude pratique sur le Laryngoscope et sur l'application des remèdes topiques dans les voies*

almost insensibly to find their way down the pharynx, may become applied to the upper part of the larynx, and even diffuse themselves to some extent over its internal surface. The lozenges that appear to prove most useful are those containing chloride of ammonium, with or without cayenne, and the 'red-gum lozenges' made by Messrs. Squire.

In this, as in other chronic laryngeal affections, the beard should be worn; and all due general precautions should be taken: for, as need scarcely be stated, an attack of ordinary catarrhal laryngitis may be readily excited.

Tonics and other constitutional remedies, varied according to circumstances, often prove very beneficial. It is especially necessary to reassure the mind of the patient; for he is but too often depressed in spirits, and apt to think his malady far more serious than it really is.

Phthisical Laryngitis. Tuberculous Laryngitis. Throat Consumption.

The larynx is found to be more or less seriously affected in a very large proportion of cases of tubercular phthisis.[1] In some rare cases. the earliest recognisable indications of the commencement of the malady appear in the larynx. It is usually, however, a secondary manifestation, is rarely developed before puberty, being common in adults between the ages of twenty and thirty, affecting men more than women. In many cases, when the malady is fully established, the laryngeal symptoms are the chief if not the only source of the distress from which the patient suffers. In others, again, the condition of the larynx gives rise to effects which may to a considerable extent mask or simulate the physical signs and symptoms of incipient, and even of advanced, pulmonary disease; and thus the diagnosis may be rendered very difficult.[2] Hence the importance of making careful laryngoscopical examinations in all cases of suspected phthisis, and especially in such as present indications of laryngeal mischief.[3] There can be no doubt, I think, that most of the so-called 'cures of consumption' said to have been effected by local applications and inhalations (in so far as the accounts given may be considered reliable) have occurred in cases in which the larynx has been principally, if not solely, affected.

In the very earliest stages, the *symptoms* of phthisical laryngitis are simply weakness, uncertainty, slight huskiness, and occasional failure of the voice, together with a more or less constant desire to clear the throat of the thick whitish mucus which accumulates from time to time. On *laryngoscopical examination*, the mucous membrane is seen to present a peculiar dotted granular appearance, which is usually first, and as a rule most conspicuously, manifest on the posterior aspect of the epiglottis. This appearance is probably associated with the earliest deposit of tubercular material taking place in minute quantities at many distinct points. Somewhat later, the mucous membrane covering the arytenoid cartilages, and the aryteno-epiglottidean and interarytenoidean folds are affected, and sometimes present granulation-like elevations. At the same time, more or less thickening of the mucous membrane may be observed, and this is most commonly at first confined to the outer surfaces of the arytenoid cartilages, which appear as tumid pyriform swellings. The thickening is an important and almost characteristic feature. It is to some extent due to

respiratoires. Par le docteur Edouard Fournié. Paris, 1863. Also *L'Union médicale*, 5 fév. 1863, p. 248.

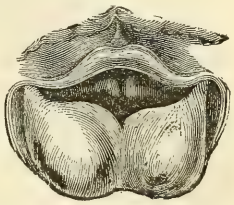
[1] Louis states that he found ulceration of the larynx in 63 out of 193 cases of phthisis which he examined. *Researches on Phthisis*. By P. C. A. Louis, M.D. *Sydenham Soc. Trans*. Lond 1844. According to the records of post-mortem examinations made at Guy's Hospital during six years, it appears that the larynx was affected in 47 out of 145 cases. The epiglottis is considered as part of the larynx; some cases, therefore, are included in these numbers in which the epiglottis only was affected.

[2] Cases occur from time to time in which affections of the larynx and trachea so closely simulate pulmonary disease that the patients are falsely supposed to be in a state of 'hopeless consumption.' On this subject see especially Dr. Scott Alison *On Morbid Conditions of the Throat in their Relation to Pulmonary Consumption*, p. 10 *et seq*. London, 1869.

[3] See the excellent remarks of Dr. Marcet on the value of the laryngoscope in the diagnosis of phthisis, in his Work *On Diseases of the Larynx*, *op. cit*. p. 80 *et seq*.

increased deposit of tubercular material as well as to inflammatory infiltration. The false and true vocal cords, as a rule, become implicated only at a still later period, and usually on one side first. The false vocal cords partake of the general thickening, and often hide the true vocal cords; and these latter lose their clearness and brilliancy. In many cases, the first evidence of the disease is a peculiar pallor of the mucous membrane, not only of the larynx, but also of the mouth, palate, and pharynx, due to impaired nutrition. As the malady advances, ulceration occurs in one part or other, and usually first on the posterior aspect and lower part of the epiglottis. At or about this period, the voice becomes hoarse; breathing is carried on with a sense of effort, and sometimes with difficulty and pain; the cough (before rare, and indeed often little more than a more or less frequent 'hemming') becomes constant, and sometimes painful; the expectoration is increased in quantity, and somewhat changed in character, becoming yellowish and occasionally slightly streaked with blood; and sometimes, according to the position of the ulceration, there is pain in swallowing. So long as the ulceration is confined to the posterior surface of the epiglottis, swallowing is easy; but when the edges, upper border, and anterior surface of the epiglottis, and especially the glosso-epiglottidean folds, are implicated, swallowing becomes painful. The ulcerative process, after it has once commenced, goes on—slowly, it may be, but surely nevertheless. It extends gradually, not only superficially, but also in depth. Fresh centres of ulceration often appear; and bye-and-bye the deeper structures, areolar tissue, cartilages, &c., become involved, and in turn destroyed. Inflammatory swelling and œdema of the surrounding parts supervene. When the perichondrium is attacked, the subjacent cartilage may either share in the ulceration and become gradually eaten away, as frequently happens to a greater or less extent with the epiglottis; or it may become partially or wholly necrotic, and may give rise to the formation of an abscess, in the midst of which the necrosed portions may remain for a longer or shorter period. The arytenoid cartilages appear to be most frequently and earliest liable to become necrotic; next the cricoid cartilage. The thyroid is comparatively rarely affected in this way. It would seem that before becoming necrosed the cartilage generally undergoes a process of calcification. Concomitantly with these morbid changes, the expectoration becomes abundant and purulent; the voice is lost; breathing becomes more constantly difficult and painful; and from time to time the most distressing paroxysms of spasmodic dyspnœa may come on. Under such circumstances, laryngoscopical examination is often very difficult, not only on account of the general state of the patient, and the hyperæsthetic condition of the pharynx commonly existing in such cases, but also on account of the malposition, deformity, and swelling of the epiglottis resulting from the disease, and the abundant mucopurulent secretion by which the view is often completely obscured. When, however, a view is obtained, some idea may be formed as to the character and extent of the ulceration and destruction of parts that may have taken place. And it will usually be observed that the epiglottis and the posterior and upper parts of the larynx have suffered to the greatest extent; and that the ulcers are surrounded by more or less considerable thickening of the surrounding parts. Sometimes even projecting points of necrosed cartilage may be seen exposed, or bathed in pus. Post-mortem examination (the opportunity for which, as a rule, speedily occurs) confirms the correctness of such observations, as well as the inferences drawn from them.

FIG. 151. — Laryngeal Phthisis, showing pyriform swelling of the ary-epiglottic folds. (Mackenzie.)



In some cases the ulcerative process does not commence so early, nor extend so deeply, as thus stated; and it may even happen that healing may take place. In certain exceptional cases under favourable circumstances the process of healing may be watched from time to time by aid of the laryngoscope, as I know from my own observation, as well as from the statements of others. And further, it is by no means very unusual to find on post-mortem examination the cicatrices of healed

ulcers in the larynges of those who have died of phthisis. In other cases thickening followed by softening, and it may be by subsequent absorption, without definite ulceration, may be observed to take place in localised patches. During this process there is abundant expectoration of thick whitish mucus. In all such cases the symptoms are proportionately less severe and the progress of the malady is much slower than in cases of the class first described. Post-mortem examination not unfrequently shows more or less pronounced affection of the larynx in cases in which during life there have been scarcely any laryngeal symptoms beyond slight hoarseness, or some other alteration of the voice.

The *course and duration* of phthisical laryngitis vary greatly, not only with the special character and type of the local affection, but also still more notably with the degree of development and severity attained by the pulmonary disease, and the general morbid condition at the period at which the larynx first begins to suffer. Thus, in the first place, as already stated, the disease may in certain rare cases begin in the larynx, and there may be no indications whatever of the presence of tubercle in any other part. In the second place, the larynx may appear to become affected almost simultaneously with the lungs, and the disease in the two parts may go on almost *pari passu*. In the third place, the affection of the larynx may be consecutive to advanced disease and disorganisation of the lungs, and may even supervene, as it were, almost at the very termination of the case.

In cases belonging to the first class indicated, the progress may be comparatively rapid, and the patient may die asphyxiated from the results of the laryngeal disease alone; or exhaustion may come on gradually. More frequently, however, the progress of the malady is slow; and sometimes apparent or even actual recovery of temporary character may take place. But sooner or later the malady appears afresh, often with greatly increased severity; and all the signs and symptoms of pulmonary mischief become manifest.

In cases belonging to the second and third classes indicated, the downward progress is almost invariably more or less rapid. It too often happens that the patient seems prematurely hurried to his end by the difficulty of breathing and swallowing, and all the various sources of distress associated with the laryngeal complications of his fatal but otherwise almost painless malady.

It may be broadly stated, however, that patients afflicted with this malady rarely survive longer than two years, the largest proportion dying between the twelfth and the eighteenth month after the first onset of the laryngeal mischief.

Treatment.—It would be altogether out of place to discuss in these pages the constitutional treatment requisite in tubercular affections generally, and in pulmonary phthisis especially. Suffice it to say, that similar constitutional treatment is indicated in phthisical laryngitis. It must ever be borne in mind that this malady is but a local expression, so to speak, of a general morbid tendency, to modify which all possible endeavours must be made. At the same time, the part affected is so important, and the associated danger and suffering may be so great, that no measures must be neglected by means of which the symptoms may be alleviated and the danger averted, if only for a time. Experience amply shows that in such respect local treatment is often very beneficial.

In the earliest stages it does not appear that any typical applications are likely to be efficacious in arresting the malady; but rest to the parts affected, and avoidance of all sources of irritation, may afford opportunity for general improvement under constitutional treatment. But when once ulceration has commenced the need for local treatment arises, and indeed may become most urgent. Soothing inhalations of the steam from hot water in which hemlock, hops, stramonium, or opium have been infused, often afford much comfort. So also do spray inhalations of anodyne solutions. Similar solutions applied by the brush are sometimes very useful. They may not cure, but they give the temporary relief the sufferer so often and so anxiously looks for. An excellent formula quoted from Krishaber[1] is as follows: Extract of opium and extract of belladonna equal parts, dissolved in forty parts of cherry-laurel

[1] *Op. cit.* p. 674.

water. The beneficial effects of this application, although transient, are immediate and almost invariable. The insufflation of $\frac{1}{8}$ of a grain of morphia, once or twice daily, often greatly alleviates the cough. This should be mixed with a couple of grains of starch.

Small ulcers may often be advantageously touched with the solid nitrate of silver: a protective covering from the irritating influence of the passing breath is thus formed for them. But the application of the solution of nitrate of silver to the mucous membrane generally appears in many cases to do harm rather than good. Marcet recommends repeated scarification of the thickened parts of the mucous membrane.[1]

In cases in which the dyspnœa is great, and clearly dependent upon the condition of the larynx—in cases especially in which there is great difficulty in swallowing, and consequent danger of death from want of sufficient nourishment—tracheotomy should be performed without hesitation.[2] The existence of even extensive disease in the lungs cannot be regarded as forbidding the adoption of this certain mode of relief from those symptoms which alone are distressing. Death from pulmonary phthisis is always easy; but death from laryngeal phthisis is preceded and attended by the direst suffering. Tracheotomy cannot ward off the one mode of death; but it is powerful to rob the other of its horrors. I have seen such immediate and such complete relief afforded by the operation in several cases, about the hopeless character of which there could be no doubt, that I should never hesitate to repeat it in similar cases, feeling certain that though life may not be saved, it may be prolonged, and suffering may assuredly be diminished during the remaining days. Further, it may be added that cases do occur from time to time in which the whole disease is in the larynx, although the accompanying symptoms and wasting closely resemble those of general phthisis, and the physical signs are so far obscured as to afford no reliable indications. Three cases have come under my observation, in each of which the patient had been pronounced to be dying of 'hopeless consumption.' In each of these, more or less complete recovery speedily followed the performance of tracheotomy.

Syphilitic Laryngitis.

Syphilitic affections of the larynx are comparatively common.[3] They vary in character and importance with the period of the disease at which they arise, and also with the general health and condition of the patient.

During the *Secondary Stages* of Syphilis the mucous membrane of the larynx may be affected in a manner corresponding with the cutaneous eruption present; or it may become ulcerated, either independently, or in direct continuity with the characteristic ulceration of the soft palate, fauces, and pharynx, which so commonly occurs. The actual existence of the several conditions referred to has been fully established in very many cases, and may as a rule be readily recognised, by aid of the laryngoscope.[4] Without such aid the precise condition of the larynx in any particular case can only be inferred from the symptoms; and a considerable degree of uncertainty necessarily attends the diagnosis.[5]

Erythema of the laryngeal mucous membrane often occurs in association with

[1] *Op. cit.* p. 95.

[2] It is very desirable, in every case where swallowing is difficult, to thicken the food of the patient by adding to it corn-flour or arrowroot.

[3] According to my own experience a very large proportion (from thirty to forty per cent.) of the cases of laryngeal disease met with in hospital practice, among the surgical out-patients, are of syphilitic origin. In private practice the proportion is very much smaller, but still considerable.

[4] On this subject, see especially the brochure of M. Dance, *Sur les éruptions du Larynx dans la période secondaire de la Syphilis.* Paris, 1864.

[5] Gerhardt and Roth state that in eight out of fifty-four cases of secondary syphilis under observation in Würzburg Hospital, the hoarseness was produced by mucous patches or condylomata of the larynx, which could be distinctly seen by aid of the laryngoscope. *Arch. für path. Anat.* Bd. xxi. Heft 1.

syphilitic roseola of the skin. It may either extend from the fauces to the epiglottis and upper part of the larynx, and thence spread over the whole mucous surface; or it may appear in isolated and more or less well-defined patches. The mucous membrane in the parts affected presents on laryngoscopical inspection a dusky red or even purplish hue, and, it may be, a slightly elevated or swollen appearance.

More distinctly elevated and better defined patches (*mucous patches*) are sometimes seen in association with papular, squamous, and especially with tubercular affections of the skin.

The *symptoms* accompanying these comparatively simple conditions are not, as a rule, severe; nor are the results likely to prove serious. The voice is generally altered to some extent; it may become weak, wanting in tone, husky, or somewhat hoarse. But there is neither dyspnœa nor troublesome cough; nor is there local pain, nor any difficulty in swallowing that can be referred to the affection of the larynx.

The peculiar character of the voice so constantly noticed in secondary syphilis, and by some considered almost pathognomonic, would appear to depend in great measure upon one or other of the conditions of the larynx thus described, rather than upon the concomitant affection of the palate, fauces, and nasopharyngeal mucous membrane, the existence of which is more readily obvious, and to which alone the explanation is commonly attributed. Such, at any rate, is the conclusion indicated by the results of my own observations, as well as by those of others. It must be borne in mind that an affection of the mucous membrane of the larynx which is only superficial, and to the eye of the observer appears slight, may nevertheless, directly or indirectly, hamper to a considerable extent the movements necessary for the production of the natural voice.

It sometimes happens that laryngeal symptoms, similar in character to those just described, and associated with similar laryngoscopical appearances, arise either gradually, or almost suddenly, five or six months after the commencement of the malady, and after all obvious affections of the fauces and pharynx have subsided.

Syphilitic ulceration, as already stated, may extend from the fauces and pharynx to the larynx. But it very rarely does so during the secondary stages, except in cases in which the general health and strength are much broken down, or in which there has been continuous or frequent exposure, during the course of the malady, to the ordinary causes of acute laryngitis.

Occasionally small isolated spots of superficial ulceration, similar to those often observed in the mouth, appear on the laryngeal mucous membrane.

During the *tertiary stages* of syphilis the larynx is frequently affected in one way or other, and in many cases to a very serious extent.

Papulo-tubercular elevations of the mucous membrane are by no means rare. They vary in size, and also in situation. In some instances they simulate warty growths of more innocent origin; in others they more or less closely resemble the condylomata met with on other mucous surfaces.[1] Sometimes these elevations subside under appropriate treatment, or perhaps spontaneously. In rare instances they increase to such size as to necessitate removal by operation. Sometimes they ulcerate and form the starting-points of ulcerations, such as are described in the next paragraph. They have been observed on the false and on the true vocal cords, as well as on various other parts of the laryngeal mucous membrane. The chief *symptoms* noticed are hoarseness, or some other marked alteration of the voice, and sometimes occasional fits of dyspnœa.

Tertiary ulcerations of the larynx are comparatively common. They may commence either superficially in the mucous membrane, and thence penetrate to the subjacent structures; or they may result from the effects of some more deeply seated affection—as, for example, softening down of gummatous deposit in the submucous

[1] M. Cusco has especially called attention to growths of this description, and to their syphilitic origin (see M. Dance, *op. cit.*) His observations accord with those of Türck and other observers, and are confirmed by my own experience.

tissue, or perichondritis or chondritis—followed by the formation of abscess. They may occur singly, and in any part; usually, however, several spots are attacked, either simultaneously or one after another. The epiglottis is generally affected first, and in a large proportion of cases is the part most extensively destroyed. Sometimes its edges are gradually eaten away; sometimes its substance early becomes perforated, and the perforation extends until the edges are reached. In such cases semi-detached portions, flapping loosely, occasionally give rise to much embarrassment. The false and true vocal cords are often affected—in some cases by comparatively superficial, but in most by deeply penetrating, ulceration. The mucous membrane covering the arytenoid cartilages, and the posterior part of the larynx generally, is comparatively less frequently and less early attacked by syphilitic than by phthisical ulceration: but it is liable to become involved sooner or later. The cartilages (and especially the arytenoids) may become carious or necrotic, as the result either of deep extension of ulceration commencing in the mucous membrane, or of perichondritis arising independently of any such superficial affection. Portions of dead cartilage may become detached, and, acting as foreign bodies, may give rise to the most serious symptoms; or they may be expectorated, or removed by operation; or they may remain at any rate partially fixed, and in such case may become the foci of abscesses, and the excitants from time to time of the most dangerous paroxysms of spasmodic dyspnœa.

The *symptoms* vary according to the extent of the ulceration and the part especially affected. There is invariably marked alteration of the voice, sometimes hoarseness, sometimes complete aphonia, and sometimes one or other of the various intermediate conditions which are readily recognisable but difficult to describe or name. There may or may not be dyspnœa; and the dyspnœa, if present, may be slight, or of the most distressing character. In some instances, and especially in those in which the cartilages are affected, there may be occasional attacks of severe dyspnœa, with intervening periods of comparative or even complete ease; and sometimes suffocative spasm of the larynx may occur.

Two or three years ago, a patient (in the Venereal Ward in Guy's Hospital), who had suffered from occasional and slight but evanescent attacks of dyspnœa, was suddenly seized with such urgent and distressing difficulty of breathing, that he rushed from the ward to seek help. He reached the bottom of the stairs, and there fell dead from suffocation. On post-mortem examination, a detached portion of necrosed cartilage was found in the glottis.

It is well to bear in mind, therefore, that in such cases dyspnœa of the most dangerous character may supervene suddenly, and almost without warning. Indeed, it may be asserted that patients suffering from severe tertiary affections of the larynx require the most careful watching, for danger may arise at any moment. In some cases there is difficulty in swallowing; and often more difficulty in swallowing fluids than solids. The former (on account of the condition of the epiglottis) are more liable than the latter to 'go down the wrong way.' But the slight degree of difficulty, and the absence of all pain in swallowing, sometimes observed in certain exceptional cases of this kind, in which the epiglottis has been even extensively destroyed, are very remarkable.

The *course and duration* of these tertiary affections of the larynx, as may be readily understood, vary greatly. In some cases, under appropriate treatment, cicatrisation may take place; but in such it constantly happens that very serious deformities of the parts result either from the loss of substance, or from the subsequent contraction of the cicatrices that may have occurred. The voice is, as a rule, permanently impaired; and breathing and swallowing may be rendered more or less difficult. Attacks of acute laryngitis, attended by more or less spasm, are liable to be excited by comparatively slight causes, and may lead to a fatal result if timely relief is not afforded, or if the safety of the patient has not been previously secured by the performance of tracheotomy.

The *general diagnosis* of syphilitic affections of the larynx is not often difficult. The history of the case, and the presence of the syphilitic cachexia, together with the coexistence of some more unmistakable signs or symptoms (such as ulcers or cicatrices

about the palate and fauces, cutaneous eruptions, nodes on the tibiæ, &c.) generally serve to indicate the nature of the malady.

But beyond the general indications afforded by the history of the case, and by the presence or absence of other local affections of syphilitic origin, certain special indications may be obtained, and the diagnosis may often be clearly established, by aid of the laryngoscope.

The dusky hue and patchy appearance of syphilitic erythema of the larynx differ notably from the bright diffused redness of simple catarrhal inflammation; and the papules, flattened tubercular elevations of surface, and condylomata of syphilis can hardly be mistaken for the enlarged mucous follicles of glandular laryngitis—still less for the dotted, granular appearances presented in the earlier stages of laryngeal phthisis. There may, however, be considerable difficulty in distinguishing between a syphilitic tubercle or condyloma beginning to ulcerate, and a small epithelioma, especially if situated on the posterior wall of the larynx. Such difficulty has arisen in more than one instance under my observation. In any doubtful case it is well to try the experiment of 'specific' treatment before expressing any decided opinion. Antisyphilitic remedies and local treatment will almost certainly effect a cure in the one case; and in the other, though necessarily useless, they cannot do any great amount of harm.

The deep and extensive ulceration of the more advanced stages of syphilitic disease of the larynx not only gives rise to symptoms, but on laryngoscopical inspection may present appearances which more or less closely resemble those of phthisical disease on the one hand, and epithelioma on the other. It may not be easy, but it is always important, to determine accurately the nature of the malady, as well as the extent of the mischief. For, as need scarcely be stated, the treatment which is requisite and likely to prove more or less successful in cases of syphilitic origin, might be absolutely injurious in those associated with phthisis, and altogether useless, or perhaps worse than useless, in epitheliomatous disease. The prognosis also must obviously depend in great measure upon the satisfactory determination of the origin of the local affection.

The chief distinctive features presented by syphilitic, phthisical, and epitheliomatous ulceration of the larynx may be stated as follows.

Syphilitic ulceration usually attacks the epiglottis first, and most frequently its upper surface. It extends rapidly, perhaps in the course of a few days, and is emphatically destructive in its progress. It involves the submucous tissues at a comparatively early period; and thus the whole thickness of the epiglottis may speedily become perforated, or some other part of the larynx may suffer corresponding destruction of substance. It is not, as a rule, surrounded by any marked or extensive thickening; but its edges are often more or less swollen, and red. Such apparent or real thickening as there may be generally attends rather than precedes the ulcerative process.[1] The accompanying expectoration is thick, tenacious, and yellow, or yellowish green in colour.

Phthisical ulceration usually commences in the mucous membrane covering the upper and anterior parts of the arytenoid cartilages. The posterior aspect of the epiglottis may often be seen at the same time free from ulceration, but presenting the dotted granular appearance already described. It is almost invariably preceded as well as always attended by marked and characteristic thickening. It progresses very slowly; and, as a rule, does not penetrate at an early period to the deeper structures. When it attacks the epiglottis, the edges present an irregular, somewhat worm-eaten and greyish appearance, but the under surface is usually first attacked. The ulcers are smaller, and almost always numerous. The accompanying expectoration is generally more frothy, and thinner, and more mucopurulent in character than in syphilitic ulceration, and much more abundant than in epithelioma.

Epitheliomatous ulceration of the larynx in a very large proportion of cases commences on the pharyngeal aspect of the mucous membrane covering the arytenoid or

[1] The ulcers thus formed are deep and most often solitary.

cricoid cartilages, and comparatively rarely in the interior of the larynx. It is associated with very considerable and irregular thickening, due to the development and increase of the new growth. Its surface presents a dirty greyish appearance, and its edges are elevated. It progresses slowly. The accompanying expectoration, at any rate during the earlier stages, is scanty, thin, and often more or less sanious in character. In the advanced stages it becomes abundant, more or less purulent, and sometimes tinged with blood.

The other local and constitutional signs and symptoms, which in syphilitic and phthisical cases may aid the diagnosis, are altogether wanting in cases in which the laryngeal ulceration is simply epitheliomatous in origin.

Lupous and other Strumous ulcerations of the larynx which cannot, strictly speaking, be classed as phthisical, sometimes occur,[1] and are with difficulty distinguished from those of syphilitic origin. In some cases of the kind that have come under my observation, it has seemed that the affection has probably been due to congenital syphilis. The age of the patient, the history of the case, and the presence or absence of other local or general indications, afford the best guides in the diagnosis.

Treatment.—In syphilitic laryngitis, local as well as constitutional treatment is very often necessary, and in the more severe forms is urgently—nay, imperatively demanded.

The comparatively slight affections which so commonly occur during the secondary stages of the malady, and in which there is simply diffused or patchy erythema of the mucous membrane with but little swelling, as a rule, subside under constitutional treatment. But all unnecessary exertion of the voice, and especially exposure to cold and wet, should be sedulously avoided. Mercury in one form or other is the only remedy upon which any reliance can be placed; and the appearance of laryngeal symptoms may generally be accepted as an indication that it is desirable to get the system under the influence of this drug as speedily as may be practicable and safe. The use of the calomel vapour bath may be especially recommended in such cases, inasmuch as beyond its general efficiency it affords special facility for the occasional inhalation, and thereby the local application, of the mercurial vapour. The value of such inhalation, however, is more pronounced in cases in which ulceration has commenced.

Secondary ulcerations of the laryngeal mucous membrane (whether in continuity with others about the fauces or pharynx, or appearing independently) may often be advantageously treated by local applications. But such applications must be regarded simply as adjuvants to the general treatment indicated, and not as in any measure rendering such general treatment unnecessary. The frequent inhalation of the spray of weak solutions of perchloride of mercury with chloride of ammonium, or of sulphate of copper, very often appears to be beneficial. In some cases the insufflation of calomel, or an occasional inhalation of the vapour of calomel, may be recommended. In other cases the application of solid nitrate of silver or sulphate of copper, from time to time, to the ulcerated surface does good. If there is much irritability, however, the inhalation of warm soothing vapours, or the spray of anodyne solutions, is for a time preferable.

Syphilitic affections of the larynx occurring during the tertiary stages of the malady almost invariably require the administration of iodide of potassium in full doses (gr. xx. to gr. xxx.) three or four times a day. In some cases the addition of iodine may be useful. In others, iodide of iron and tonics generally are indicated. Local measures are very often necessary in conjunction with the constitutional treatment indicated, and in all cases may do much to aid the cure. Condylomatous and papillary elevations of the surface may be touched daily, or less frequently, with the solid nitrate of silver. In cases in which ulceration has occurred, inhalations of the vapour of iodine, or of the spray of solutions of iodide of potassium, and iodine are very useful. If the ulcers are comparatively superficial, the application of solid sulphate of copper daily, or twice daily, often proves beneficial. If the ulcerated surface is extensive, a saturated solution of sul-

[1] See Türck, *op. cit.* p. 425.

phate of copper may be advantageously applied by the brush. Cases occasionally occur in which the internal administration and also the local application of mercurials in conjunction with preparations of iodine are indicated. The more powerful applications and medicines may sometimes be beneficially alternated from time to time with the exhibition of chlorate of potash, both locally in the form of solutions, spray, or powder, and internally in combination with tonics. Swollen and œdematous parts of the mucous membrane may be freely scarified with the greatest advantage; and any spot at which an abscess appears to have formed may be punctured. If any portion of exposed and necrosed cartilage should be seen, an attempt may be made to remove it by means of appropriate forceps.

In every case in which breathing becomes seriously impeded, whether in the secondary or tertiary stages of the malady, tracheotomy should be performed without hesitation. Ample experience proves that in syphilitic disease of the larynx this operation may be regarded as fairly successful, not only in averting impending danger, but also in affording opportunity for the more or less complete restoration of the parts affected.[1] The operation is especially called for in cases in which paroxysms of spasmodic dyspnœa have occurred, or in which laryngoscopic examination shows that the ulceration is extensive and deep, and some portion or other of necrotic or carious cartilage is exposed. In such cases recovery without operation, though by no means impossible,[2] is at any rate improbable; and the patient is in peril of his life (peril which at any moment may become imminent) until a new way of breathing is secured to him.

The cicatrices of syphilitic ulcers of the larynx have a great disposition to contract, and such disposition is favoured in many cases by the loss of substance which may have occurred. Permanent impairment of the voice, and more or less serious impediment to respiration, may result. It not unfrequently happens that tracheotomy becomes necessary after partial or complete cicatrisation has taken place, in consequence either of the resulting contraction of the parts, or of an attack of laryngitis incidentally occurring. The damaged parts are prone to a low sub-acute or chronic form of inflammation, which at any moment may become exacerbated and give rise to urgent symptoms. In some cases the passage gradually becomes more and more free in consequence of the absorption of effused material; and in such, if it should have been necessary to perform tracheotomy, the cannula may be removed at an earlier or later period. In other cases the contraction increases, and the tracheotomy cannula must be worn during the remainder of life. In some few cases it may seem desirable to divide the cicatrices by operation, and to attempt the dilatation of the air-passage. But so far as I have been able to ascertain, no very satisfactory result has hitherto been obtained in any case in which the mischief has been in the larynx itself. Much good, however, has been effected in several cases in which the contractions have been situated above the larynx. Some encouragement to further attempts may perhaps be derived from the successful results which have been obtained in instances in which the contractions have resulted from the effects of injuries, although, as is obvious, the conditions in such cases must necessarily be somewhat different.[3] Dr. Mackenzie speaks highly of Dr. Whisker's 'cutting dilator' in those cases in which a web has formed in the larynx. Professor Schroetter's dilator, in cases in which tracheotomy has been first performed, may occasionally be used with advantage.

[1] In 38 out of 72 cases of tracheotomy on account of syphilitic disease of the larynx which have come under Mr. Durham's observation, or of which he collected particulars, life was preserved. In 19 of these the patients were enabled sooner or later to dispense with the cannula; in 10 it was necessary to wear the cannula permanently; in 9 the ultimate results are not stated.

[2] See a remarkable case recorded by Gibb (*op. cit.* p. 38) in which a crater-like elevation was seen on one side of the glottis. From this, portions of the cricoid cartilage were discharged and expectorated on three different occasions.

[3] See the article on INJURIES OF THE NECK.

Erysipelatous Laryngitis.

Erysipelatous laryngitis in its severer forms is an extremely dangerous but happily by no means a common affection. It is most frequently met with, perhaps, in hospital practice at periods when erysipelas is prevalent. It may either occur in association with erysipelas of the face and neck by direct extension to the fauces, and thence to the larynx; or the fauces and larynx may be first affected, and death may ensue without any appearance of erysipelatous redness on the external surface.

The *local symptoms* are:—soreness of the throat; difficulty in swallowing; pain and tenderness about the larynx; hoarseness, and subsequently extinction of the voice; and difficulty in breathing, which may rapidly become more and more urgent. These local symptoms are preceded and attended by the constitutional symptoms (such as feverishness, rigors, &c.) associated with erysipelas generally. On *inspection*, the mucous membrane of the fauces is seen to be unnaturally red and swollen, and sometimes more or less dry and shining. By aid of the laryngoscope, the mucous membrane of the larynx may be seen to be similarly affected. As the malady advances the submucous tissue becomes infiltrated; the swelling increases, and its œdematous character is pronounced; the glottis becomes more and more encroached upon, and respiration is consequently more and more impeded.

Unless the malady is checked in its progress, or relief is afforded from the urgent symptoms, the patient usually sinks into a 'typhoid' state, and dies either from exhaustion or suffocation. Such is the common result.

On *post-mortem examination* the mucous membrane of the larynx appears inflamed, swollen, and œdematous. In many instances it is of a dirty greenish colour in places; and the submucous tissue is infiltrated with seropurulent matter, and here and there sloughy. Small collections of pus and sloughs of the areolar tissue are occasionally seen round the glottis. The tracheal mucous membrane is also often found to be inflamed. The mucous membrane of the fauces is similarly affected; and the base of the tongue and the tonsils sometimes present a more or less extensive sloughy appearance.

Treatment.—The general treatment must be from the first stimulating and supporting; and no effort must be spared to counteract the depressing influences of the disease. As much nourishing and easily digestible food as can be taken, together with a very liberal allowance of wine or brandy, should be given at frequent intervals in such proportions as can be swallowed. The tincture of the perchloride of iron with quinine should be administered in full doses, or some other powerful tonic combined with chlorate of potash, or ammonia.

In some cases it may be desirable to commence the treatment by the administration of an emetic followed by a purge. But the propriety of so doing must be decided by the general condition of the patient, and the progress the malady may have made. Locally, the application of a strong solution of nitrate of silver or perchloride of iron may be recommended in the earlier stages. The insufflation of morphia ($\frac{1}{4}$ gr.) mixed with starch twice or thrice daily, the patient at the same time constantly sucking ice, together with the internal administration of bromide of potassium, has been attended with success. In the more advanced stages, especially when there is much œdema, free scarification of the mucous membrane, and frequent inhalations of warm soothing vapours and steam, may afford the most marked relief. If the dyspnœa becomes urgent, tracheotomy must be performed. It is true that from the nature of the malady there is often but little hope of a successful result; at the same time there can be no doubt but that by the operation a chance of prolonging life is afforded that could not otherwise be obtained; and that by it at any rate the last hours of the patient may be rendered comparatively free from suffering.[1]

It may be worthy of remark that, apart altogether from any such serious affection as that thus described, it not unfrequently happens that in cases of erysipelas of the

[1] A fatal result ensued in 10 out of 15 cases of tracheotomy performed on account of erysipelatous laryngitis which have come under Mr. Durham's observation, or of which he collected particulars; in 5 cases the patients made good recoveries.

scalp and face there is some soreness of the throat, slight difficulty of breathing, and some alteration of the voice, such as weakness or hoarseness.

Diffuse Cellular Laryngitis. Acute Œdematous Laryngitis.

Diffuse inflammation of the areolar tissue of the larynx is a comparatively rare but very formidable malady. It corresponds to the diffuse cellular inflammation not unfrequently met with in other parts of the body; but it is especially dangerous on account of the impediment to respiration and swallowing to which from its situation it necessarily gives rise. It is probably closely allied in nature to erysipelatous inflammation, from which, however, it differs in the fact that in it the submucous tissue is primarily attacked, and the mucous surface is left free, or only becomes secondarily affected. In erysipelas, on the other hand, the mucous surface is first affected, and the submucous tissue is only secondarily or concomitantly involved.

Diffuse cellular laryngitis may either occur in association with previously existing diffuse cellular inflammation of the neck, in which case it seems to form a part of the more general affection; or it may commence in or about the submucous tissue of the pharynx and larynx, and thence spread through the neck generally. In some instances, however, it may cause death from suffocation or exhaustion before any considerable extension to other parts can have taken place.

In this malady the appearance of the local affection is usually preceded, and its onward progress is invariably attended by more or less severe constitutional disturbance, and especially by great general depression. At the onset the patient often complains of having felt unwell for some days, and of having suffered from headache, lassitude, lowness of spirits, and other febrile symptoms. Soreness of the throat, at first slight, but rapidly becoming severe, is noticed early; and rigors soon occur. As the malady progresses breathing becomes impeded; and a sense of weight and oppression at the chest is complained of. There may be slight hacking cough, attended by the expectoration of a little whitish glairy mucus. The soreness of the throat increases; the fauces and tonsils become much swollen, and of a dusky red colour; and sometimes ulcerated patches appear upon them. Somewhat later the glands behind and below the jaw become enlarged; the neck becomes painful; and the mouth can only be opened with difficulty. The throat is tender when external pressure is made on one side or both. Occasionally a constant and profuse discharge of saliva takes place. Still later, the neck becomes swollen, and the swelling extends and increases; respiration is more and more impeded; and swallowing is rendered almost or quite impossible. The patient sinks into a typhoid condition, and dies exhausted; or, as perhaps more frequently happens, he is killed by a process of slow asphyxiation. In some cases, however, a sudden paroxysm of spasmodic dyspnœa proves fatal at a comparatively early period in the progress of the malady; and in others, the laryngeal œdema increases very rapidly, and causes speedy suffocation. Either of such results may ensue before any considerable, or even any perceptible, general swelling of the neck has taken place.

The swollen and œdematous condition of the upper part of the larynx may generally be easily ascertained by digital exploration, and the impression conveyed by the finger has been likened 'to that which is given by touching the tonsils.' In the earlier stages and less severe forms of the malady, laryngoscopical examination to some extent is comparatively easy; and the mucous membrane of the upper parts of the larynx may be seen to be distended and swollen. Dr. Mackenzie thus describes the appearances as seen by the laryngoscope. 'The colour of the mucous membrane is generally light red. The epiglottis has the appearance of a semi-transparent roll-like body or ridge, or, losing its normal contour altogether, it presents two round red swellings pressed against each other. It is often merely erect and tense. It is this condition of the epiglottis which explains the pain and difficulty accompanying the act of swallowing. In many cases the swollen epiglottis blocks the view of the interior of the larynx. Occasionally, however, the ary-epiglottic folds appear distinctly as two translucent folds, which almost meet over the entrance to the larynx,

and often touch each other in the median line at each effort of inspiration. It rarely happens that the vocal cords themselves are infiltrated.'

On *post-mortem examination* extensive inflammatory œdema of the submucous tissue of the larynx and neighbouring parts is invariably found. In some cases one side is much more affected than the other. When cut into, the areolar tissues present an infiltrated, and sometimes more or less sloughy, appearance. The infiltration is serous, seropurulent, or purulent in character, according to the period at which death has occurred, and the circumstances under which it has taken place. The tissues of the neck are found in many cases to be infiltrated to a greater or less extent with serous, seropurulent, or fibrinous exudation. In cases in which there has been much swelling, they often present almost a brawny consistency. Sometimes the infiltration extends upwards behind the pharynx, sometimes downwards alongside the trachea and œsophagus, even into the mediastina. Occasionally the infiltration in the neck is purulent in character, and in some instances the areolar tissue is sloughy and putrid.

Treatment.—The same general treatment is required as that recommended in erysipelatous laryngitis. But in this malady local applications of nitrate of silver, &c., are far less likely to prove efficacious. The swollen parts should be freely and deeply scarified at a comparatively early period; and the scarification should be repeated without hesitation from time to time according to circumstances. After the scarification warm soothing vapours should be frequently, or almost constantly, inhaled for a time. At a subsequent period the spray of astringent solutions may be inhaled with advantage. Further, in cases in which the neck is much swollen, it may be desirable to make careful but free incisions into it, not only to evacuate pus or to allow of the escape of serous effusion, but also with the view of diminishing the tension and consequent pressure upon the trachea and œsophagus.

If such means fail to afford relief, and the dyspnœa is urgent, tracheotomy must be performed, although the difficulties attending the operation may be great, and the chances of a successful result may appear small.

An excellent illustration of the value of tracheotomy in cases of this kind occurred some years ago in the practice of Mr. Pollock at St. George's Hospital.

The patient (a butcher, aged 43) was admitted with severe and extensive diffuse cellular inflammation of the neck. Urgent laryngeal symptoms soon supervened. Tracheotomy was performed, and the patient made a good recovery in a comparatively short space of time.[1]

Other Forms of Laryngitis. Exanthematous Laryngitis; Traumatic Laryngitis, &c.

Consecutive inflammation of the larynx occasionally occurs in the course of various general maladies, other than those the laryngeal complications of which have been already described in detail. It is especially liable to occur in measles and typhoid fever. It is more rarely met with in smallpox and typhus, and still more rarely in scarlet fever.

The *laryngitis of measles* is catarrhal in character, and in most instances appears soon after the nasal catarrh. Respiration may be more or less embarrassed; and sometimes there is remarkable harshness of the voice, and frequent harsh cough. In young children the breathing is occasionally stridulous, and the cough ringing. The consequences are very seldom serious; but it is well to bear in mind that they may possibly become so. In some rare instances, dangerous, and even fatal, œdema of the larynx has ensued; and in some the œdema has persisted after the general symptoms have subsided. In such cases the laryngeal symptoms have appeared early, and from the first have been very acute. As a general rule, the mucous membrane of the larynx is simply affected in a manner corresponding to the cutaneous eruption;

[1] See *Lancet*, September 1863, p. 276.

and the symptoms subside as the eruption disappears. It is not often that any local treatment is necessary or desirable, beyond the application of warm poultices and fomentations to the neck, and the inhalation of warm soothing vapours. If, however, the symptoms are severe and persistent, the same treatment may be required as that recommended in cases of acute catarrhal laryngitis (see p. 669).

The *laryngitis of typhoid fever* is ulcerative and destructive in character.[1] It may either commence during the earlier or middle stages of the malady, concomitantly with the ulceration of the intestinal glands and mucous membrane, and speedily give rise to serious symptoms, or even to a fatal result; or its existence may first become manifest during the period of convalescence and after all febrile symptoms have subsided. The ulcerations which occur during the earlier stages are generally situated either on the aryteno-epiglottidean folds, in the neighbourhood of the arytenoid cartilages, or, according to Rokitansky, about the lateral walls of the larynx. They may give rise to more or less severe functional disturbance—often to cough and difficulty of swallowing, and, somewhat less frequently, to difficulty of breathing. The difficulty of breathing usually corresponds to the amount of inflammatory œdema that may have occurred. It is sometimes difficult to determine how far the cough may depend upon laryngeal, and how far upon bronchial, affection. It is probable that in a large proportion of cases, if a patient survive the general malady, these ulcerations heal favourably, like the corresponding intestinal ulcerations. But in cases in which the symptoms become manifest at a comparatively late period in the course of the malady, or in which ulceration goes on insidiously, and perhaps almost unnoticed until seeming convalescence has taken place, the perichondrium and cartilages (and especially the cricoid) are very liable to be implicated to a greater or less extent. Under such circumstances the consequences are often very serious. Necrosis of the cartilages may result in association with typhoid fever, not only from gradual penetration of the ulcerative process, but also in some cases as an effect of some deep-seated inflammatory condition commencing in or about the cartilages themselves.

A remarkable instance came under Mr. Durham's observation in Guy's Hospital, while acting as Ward Clerk to the late Dr. Addison. 'A boy, ten years of age, had apparently recovered from typhoid fever. One morning he complained of pain in the throat. A day or two afterwards he expectorated some pus. The next day his neck was observed to be swollen and emphysematous. The emphysema rapidly spread over the whole body, even to the scrotum and penis, which became enormously and peculiarly distended. Two days later death occurred. On post-mortem examination a small ulcerated opening leading down to a necrosed portion of the cricoid cartilage was found below the glottis, on the right side. Through this opening evidently the air had escaped during expiration into the areolar tissue of the neck, and had thence spread over the body. No other case of any kind has ever come under his observation in which the emphysema was so extensive and so general. The cavities as well as the superficial parts of the body were affected; and indeed it appeared probable that death had resulted from the impediment to respiration caused by the intra-thoracic emphysema.'

In a certain proportion of cases in which the symptoms are not severe, recovery may take place without any local treatment beyond the application of warm fomentations to the neck, and the inhalation of warm soothing vapours. The general treatment of typhoid fever must, of course, be carried out. In all cases, however, in which the symptoms are urgent, tracheotomy should be performed. It is undeniable that the statistical results hitherto obtained do not appear to be

[1] This affection is the *laryngo-typhus* of the Germans. It appears to have been first definitely and fully described by Louis, in whose treatise, entitled *Recherches sur la Fièvre typhoïde* (Paris, 1841), much valuable information on the subject is contained. Trousseau especially refers to the laryngeal complications of typhoid fever, and gives some excellent illustrative cases in his *Clinique médicale*, vol. i. p. 299; Paris, 1868. Chomel, Rokitansky, Wilks (*Med. Times and Gaz.*, 1862, p. 276), and others also fully discuss the pathological history, or give examples of typhoid disease of the larynx. The appearance of the ulcers is so characteristic that Louis says that, if observed in a patient who had died of some acute disease, they would be sufficient to indicate almost certainly that the affection had been typhoid fever. *Op. cit.* p. 321.

very encouraging.[1] At the same time the success which has resulted in some cases justifies resort to this operation, which indeed alone offers any chance of safety.

In the *laryngitis of small-pox* the mucous membrane of the larynx is affected in a manner which varies with the stage of the malady, and corresponds more or less closely with the more obvious external appearances. In the earlier stages, pustules may arise analogous to those observed on the cutaneous surface. Neumann, Türck, and Krishaber all state that they have seen, by aid of the laryngoscope, true variolous pustules surrounded by circumscribed inflammatory areolæ, upon the true vocal cords as well as on other parts of the laryngeal mucous membrane. The symptoms are hoarseness, cough, and more or less uncomfortableness or pain about the larynx. About the eleventh or twelfth day, at the period at which swelling of the face and extremities is especially liable to occur, œdema of the larynx may come on; and respiration may be more or less seriously, or even fatally, impeded. During the still more advanced stages of the malady, at or about the period at which abscesses are occasionally formed in other parts, perichondritis and subsequent necrosis of cartilage, with all the attendant symptoms and dangers, may ensue.

In *scarlet fever* the larynx may either be affected during the earlier stages by extension of inflammation or inflammatory œdema from the pharynx; or, in common with other parts, it may become œdematous as the result of consecutive kidney disease. The true scarlet fever eruption very rarely indeed, if ever, invades the larynx. The local treatment necessary in each case may be gathered from what has been already stated in regard to similar affections arising in connection with other maladies.

It may here be remarked that in *Bright's disease* the larynx may participate in the general œdema, and this may prove dangerous or fatal from the obstruction to respiration to which it gives rise.

Gouty laryngitis may possibly be considered to possess small claim to be described as a distinct form of disease. But it is worthy of remark that in gouty subjects chronic laryngeal affections are by no means uncommon. Sometimes they are very troublesome, and even distressing to the patient; and they are always difficult to treat successfully unless the existence of the general condition upon which they depend is fully recognised, and modified by appropriate constitutional remedies. In many cases they occur in association with gouty bronchitis and tracheitis, but even in some of these the laryngeal symptoms may attract most attention, and give rise to most trouble and danger. In certain rare instances acute laryngitis of very formidable character has been observed to occur in connection with an attack of gout.

Traumatic laryngitis has been already described in the chapters treating on the various injuries—as wounds, blows, burns, &c.—from which it may result (see article on Injuries of the Neck).

Non-malignant Tumours. Polypi.

New growths in the larynx were formerly supposed to be of very rare occurrence; and indeed, except in some few and very remarkable instances, their presence could only be determined on post-mortem examination. Since the laryngoscope has come into use, however, a large number of cases have been recorded; and many more at present unpublished have come under observation, in which growths in the larynx have not only been recognised during life, but have been successfully removed by operation. There is probably no other class of cases in which the value of the laryngoscope has been so signally demonstrated. It would appear not unlikely that this circumstance, together with the interest naturally attaching to cases of this kind,

[1] I find that out of 35 recorded cases in which tracheotomy was performed on account of 'typhoid' disease of the larynx, in 24 death ensued. In 11, life was saved; but in several of them the voice was permanently impaired, and the cannula could never be dispensed with.

and the attention consequently attracted to them, has been the means of leading to the now prevalent idea that they are even more common than is actually the fact. They are certainly more frequent than was formerly supposed; but they nevertheless constitute only a very small proportion of the affections of the larynx that come under every-day observation. Krishaber states that such growths are to be 'met with in two or three per cent. of the cases of maladies of the larynx exclusively local and chronic.'[1] My own experience would lead me to the conclusion that they are much less frequent even than this.

The new growths in the larynx met with in different cases vary in character, size, and precise situation, and also, to a corresponding extent, in the symptoms to which they give rise and in the degree of danger they immediately involve. They may occur at any period of life, but are most common between forty and fifty; in some instances they are congenital;[2] in others they do not appear until advanced age. They are rather more common in the male. No satisfactory conclusion has yet been arrived at as to the local or general determining causes of their appearance in the majority of cases, but long-continued congestion following catarrh is probably one of the most common. The professional use of the voice also is said to be highly favourable to their development. The larger proportion of laryngeal tumours are non-malignant. Papillomata are certainly the most frequent. Dr. Mackenzie, out of 100 cases, found 67 of this nature; and, of 66 cases of growths of all kinds, Cohen noted 48. Fibromata stand next in numerical order. Cystic tumours are occasionally observed springing from the epiglottis. Myxomata are very rarely met with. Mackenzie has only twice observed an angiomatous growth, and only one case of lipoma is at present recorded. In some instances they may be simply the thickened elevations of surface, or the 'vegetation-like' granulations of phthisical laryngitis. Such excrescences, however, should not be considered as true growths. Distinct tumours, however, are occasionally found in phthisical and syphilitic patients, and Cohen believes both these diseases predisposed to their development.

Papillomata or warty growths constitute a very large proportion of the new growths met with in the larynx. In structure and appearance they bear a general resemblance to growths of similar nature found in other parts; they may occur either as little warty elevations, consisting of comparatively few, and sometimes almost acuminated papillæ, or as closely packed and multitudinous villous or filipendulous outgrowths, or as densely massed 'cauliflower-like' agglomerations of elongated and enlarged papillæ, rounded or flattened at their extremities. They most frequently, perhaps, spring from the mucous membrane of the anterior part of the larynx, somewhere near the insertion of the true vocal cords. In many instances they take origin from the boundaries of the ventricles, and in some from the true vocal cords; but they may arise from almost any part of the laryngeal mucous membrane. As a rule, they are multiple in origin, and spring up simultaneously or successively in several different places. Sooner or later, they more or less completely coalesce so as to form one or many distinct masses. Some idea of the general appearance presented by growths of this kind may be conveyed by fig. 152, which is taken from a preparation in the Museum of Guy's Hospital.[3] The growths in this case form a single mass, which cannot be considered as otherwise than of moderate dimensions when compared with those met with in many other instances. It was sufficiently large, however, to lead to a fatal result. In some cases these growths increase very rapidly, and to such an extent as to fill altogether, and sometimes even to distend the cavity of the larynx. They are usually pink in colour, but sometimes bright red.

[1] *Op. cit.* p. 730.

[2] One case came under Mr. Durham's observation in which it was evident that the growth had commenced before, or immediately after, birth. Another case, also congenital, is recorded by Mackenzie (*Path. Trans.*, 1865, p. 38). Three are recorded by Gibb (*op. cit.*), and several are quoted by Causit in his *Etude sur les Polypes du Larynx chez les Enfants.* Paris, 1867. More recently Dr. Arthur Edis has related an interesting case in the Transactions of the Obstetrical Society, vol. xviii.

[3] Preparation No. 1703.

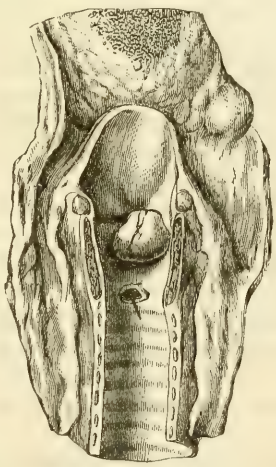
A very remarkable instance is recorded and figured by Bruns.[1] In another case of the same kind, of four or five years' standing, in which Mr. Durham removed the growths after having laid open the larynx, it appeared remarkable that such a mass as was removed could ever have found room in so small a space.[2] The laryngeal mucous membrane was literally covered by growths, which varied in size and density. The patient nevertheless made a rapid recovery, and has now a very fair voice.

In most cases the rapid increase of the growths, or the general inflammatory condition which may arise in association with their presence, and the consequent obstruction to respiration, render tracheotomy necessary, or, without this operation, lead to a fatal result at a comparatively early period. But in some instances patients suffering from laryngeal growths of this kind have been known to live for years. In such cases, it is probable that the larynx has been sufficiently cleared for breathing purposes by the detachment and expectoration of portions of the growth from time to time during coughing. Türck records a case in which the whole growth appears to have thus been got rid of.[3]

According to some observers, it would appear that these papillomatous growths occasionally undergo a process of pulpy or caseous degeneration.[4] In such cases it is easy to understand that they may become broken down and expectorated.

FIG. 152.—Papilloma of Larynx springing from border of left ventricle. Larynx opened in front.

FIG. 153.—Pedunculated Fibrous Polypus of the Larynx arising near the anterior extremity of the right ventricle of the larynx.



Fibromata or fibrous growths are met with in the larynx much less frequently than the papillary growths above described, but numerous instances are on record.

These growths are usually smooth on the surface, hemispherical, globular, or pyriform in shape, and on laryngoscopical inspection they appear somewhat paler in colour than the mucous membrane of the surrounding parts, but are sometimes brightish red. In substance they are more or less firm and compact. In structure, they resemble growths of similar nature developed in other parts; as a rule, they are solitary; they may be sessile with broad base, or pedunculated. If pedunculated, the pedicle is generally less firm and more vascular than the growth itself. In a large proportion of cases these growths are comparatively small, and do not each exceed the size of a pea; but they may attain considerable dimensions. In an instance referred to by Rokitansky, the growth was as large as a pigeon's egg.[5] A pedunculated fibrous growth of medium size is represented in fig. 153, which is taken from a specimen in the Museum of Guy's Hospital.[6]

[1] *Op. cit.* Beobachtung viii.
[2] Tracheotomy had been performed about four years previously.
[3] *Klinik der Krankheiten des Kehlkopfes. Op. cit.* Fall lxix. p. 305.
[4] See M. Causit, *Etude sur les Polypes du Larynx chez les Enfants.* Paris, 1867.
[5] *Zeitschr. d. k.k. Gesellsch. d. Aerzte z. Wien*, 1851, quoted by Krishaber. *Op. cit.* p. 730.
[6] Preparation No. 1703[20]. Tracheotomy had been performed in this case; and the patient

The larger pedunculated growths generally take origin from one or other of the true vocal cords, or from some immediately adjoining part of the ventricular wall—and in the latter case most frequently near the anterior extremity of the ventricle. They may, however, arise in other parts of the larynx, but they very seldom do so; in scarcely any instance has a growth of this kind been found connected with the mucous membrane covering the arytenoid cartilages.

Adenomatous or glandular growths are occasionally but rarely met with in the larynx. As a rule, they take origin from the mucous membrane covering the arytenoid cartilages, the aryteno-epiglottidean folds, or the base of the epiglottis,—or, in general terms, from those parts of the mucous membrane which are naturally most abundantly supplied with glandular structures. In this respect they differ remarkably from all other laryngeal growths of non-malignant character. They consist essentially of enlarged and hypertrophied glands and follicles, surrounded by more or less thickened submucous connective tissue and mucous membrane. Occasionally they appear to contain adenoid structures of new formation. They may be sessile or pedunculated. When sessile (localised glandular hypertrophy of the mucous membrane) they often present a more or less lobulated appearance; and in some instances they attain very considerable dimensions.[1] When pedunculated they are usually more or less pyriform or globular, and their peduncles are proportionately longer than those of the fibrous polypi. When seen during life, by aid of the laryngoscope, these growths are generally of a deepish red colour, but they often become pale as they advance in age. They are remarkable for the rapid changes in volume they are liable to undergo under various circumstances. Thus a slight attack of catarrhal laryngitis is almost sure to be attended by speedy and considerable increase in the size of the growth, which may, however, again become smaller as the inflammatory condition passes off.

Cystic tumours of various kinds are met with from time to time in the larynx; but instances are comparatively rare. In some cases they may possibly result from the degeneration and breaking down of myxomatous growths, as suggested by Cornil and Ranvier;[2] but more frequently, probably, they owe their origin to causes corresponding to those which lead to the development of similar cysts in other parts. In some cases their contents are serous, or serosanguinolent; in others mucous, albuminous, or synovial in character. They may occur in almost any part of the larynx, but are most common on the epiglottis, and in some cases attain considerable size.[3]

An interesting, and I believe almost unique, example of mucous cyst connected with the posterior aspect of the epiglottis, came under the care of Dr. Wilks and Mr. Durham in Guy's Hospital some few years ago. 'The patient, a delicate boy eleven years of age, had suffered two years previously from a severe attack of sore throat, and ever since had experienced more or less difficulty in swallowing. This difficulty gradually increased. His voice soon became affected, and by-and-by he began to suffer from frequent and severe attacks of dyspnœa, which often came on during sleep. On laryngoscopic examination, the epiglottis was not to be seen presenting its ordinary form; but instead of it there appeared a large rounded swelling, projecting downwards and backwards, and completely covering in and concealing the glottis. The tumour was pale in colour, shining, and somewhat translucent in appearance. It could be just reached by the finger, and was elastic, but very tense to the touch. Feeling certain that it contained fluid, Mr. Durham made a free incision into it, by means of a curved, sharp-pointed bistoury. A sudden gush of thick, glairy, muco-purulent matter took place; and after the momentary dyspnœa which occurred had subsided, the patient was relieved of all the symptoms from which he had before suffered so severely. He made a rapid recovery, and left the hospital quite well. On examination laryngoscopically four years

had for a long time been comparatively comfortable, but voiceless. One day the tube got displaced. Spasm of the larynx, conjoined with the mechanical obstruction caused by the growth, proved immediately fatal.

[1] See case quoted by Ehrmann, *Histoire des Polypes du Larynx*. Strasbourg, 1850.

[2] Quoted by Krishaber.

[3] See a remarkable case described by Gibb (*op. cit.* p. 154), in which the tumour apparently sprang from the right ventricle, and filled nearly the whole glottis.

afterwards (as well as from time to time in the interim), no indications of any return of the disease, nor indeed any very clearly perceptible mark of the incision, could be discovered.[1] A case of somewhat similar kind is recorded by Delorme, in which two cysts, with glairy albuminous contents, were found on the posterior aspect of the epiglottis of a man forty years of age, who died asphyxiated.'[2]

It is worthy of remark, perhaps, that *true hydatid cysts* are stated to have been found in the larynx in some few very exceptional cases.[3]

A few instances of *cartilaginous and osseous growths* in the larynx are on record.[4]

Besides the growths of the various kinds thus described, others of mixed form and character are occasionally met with in the larynx. Thus the fibrous, fibrocellular, and glandular elements may vary in relative proportion in such manner and to such extent as may render it impossible to assign the particular growth under examination to any definite class. And so again some growths which superficially appear papillomatous may have firm fibrous bases. And, further, the condylomata of syphilis, the thickened elevations of phthisis, and the small protuberances resulting from localised chronic inflammation in some cases can hardly be distinguished from what more properly, perhaps, ought to be regarded as 'new growths' in the strictest acceptation of the term.

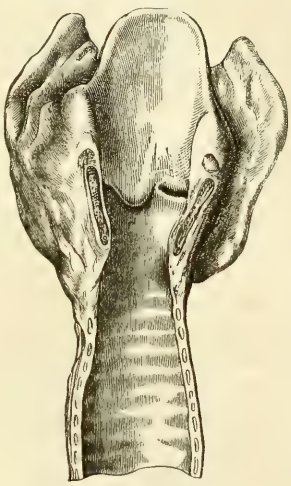


FIG. 154.—Extroversion of the Mucous Membrane of the Left Ventricle of Larynx, simulating laryngeal polypus.

A very interesting specimen was almost accidentally met with some short time since in the post-mortem room at Guy's Hospital, in which there was extroversion of the mucous membrane of the left ventricle of the larynx. Fig. 154 conveys a somewhat feeble idea of the appearance presented. The extroverted mucous membrane could be easily replaced in its proper position; and when this was done there was nothing abnormal in the appearance of the larynx. The patient had had no laryngeal symptoms.[5]

MALIGNANT TUMOURS OF LARYNX.

Cancerous growths in the larynx are for the most part *epitheliomatous* in character; but instances of *medullary cancer affecting the larynx* are not wanting. Scirrhous cancer is still more rare.

Epithelioma of the larynx generally commences on the pharyngeal aspect of the mucous membrane covering the arytenoid or cricoid cartilages, and subsequently invades the interior of the larynx. But in some instances it commences inside; and in such cases, as a rule, it first appears on the ventricular bands or on the mucous membrane of the posterior and lower part of the larynx over or near the internal surface of the cricoid cartilage, in the form of small irregular nodules, which gradually increase in size and soon ulcerate. The distinctive features of advanced epithelioma of the larynx, as seen by aid of the laryngoscope, have been already described (see p. 682).

[1] See *Transactions of Royal Med. Chir. Soc.* vol. xlvii. 1864.

[2] *Journ. de la Société de Médecine de Paris*, janvier 1808.

[3] Albers, *Gazette médicale*, fév. 1835; and Andral, *Anat. Path.* tome ii. p. 490, quoted by Ryland, *On the Diseases and Injuries of the Larynx*, Lond. 1837, p. 226.

[4] See Ryland. *Op. cit.* p. 231. *Edin. Med. Journ.* vol. xxxv. Krishaber. *Op. cit*, p. 769. Türck. *Op. cit.* Fall lxxxi. p. 321.

[5] The case is fully described by Dr. Moxon, *Trans. Path. Soc.* 1868, p. 65. The preparation is in the Museum of Guy's Hospital. Preparation 1683.

The *symptoms* to which 'new growths' or 'polypi' in the larynx give rise vary in character and severity with the dimensions and precise relations of the particular growths under observation; and also with the intensity of the inflammatory condition which in many cases may be excited by their presence, or at any rate may be sooner or later associated with it.

Difficulty of breathing, alteration or extinction of the voice, cough, and, it may be (especially in the case of cancerous growths), difficulty of swallowing; these are the symptoms—as indeed they are also the symptoms, varying only in intensity and urgency—in all serious affections of the larynx, as well as in some other maladies in which the larynx is only indirectly affected. It is very rarely indeed, if ever, that any one of these symptoms manifests such peculiarities as may be considered to indicate the presence of a 'new growth.'

In many cases when the patient first comes under observation the difficulty of breathing is so urgent, or becomes urgent so speedily, that tracheotomy must be performed before any exact diagnosis can be made. The difficulty of breathing may depend either upon the mechanical obstruction caused by the growth, or upon spasm of the larynx excited by an incidental contact of the growth with some unaccustomed or already irritated part of the highly sensitive boundaries of the glottis. A growth may exist for a long time almost harmlessly, moving in correspondence with the respiratory movements of the larynx, and then all at once may get into such position as to excite the most severe attack of spasmodic dyspnœa. This is especially likely to occur in the case of pedunculated growths. It may occur in other cases, if from any cause an attack of ordinary laryngitis should supervene; and it is always more likely to happen in children. Sessile growths by their gradual increase may gradually constrict the aperture of the glottis, and thus proportionately impede respiration, without giving rise, at least during their earlier stages, to any such suddenly serious and dangerous results as those thus indicated.

In the case of growths situated below the glottis, it may happen that expiration is almost as much impeded as inspiration.

In some cases, by means of the stethoscope placed over the larynx, a sound produced by the movements of the growth during respiration (the *bruit de drapeau* of the French) may be detected.

The voice is affected to a greater or less extent in almost all cases; and if the growths are small, and situated on the vocal cords, the affection of the voice may be the only symptom of which the patient complains. The voice may be simply changed in tone and quality and become harsh; or it may have the 'cracked pot' or 'Punch' sound; or it may be reduced to a hoarse whisper; or it may be altogether extinguished. In some exceptional cases, the voice, at first seriously affected, has been noticed to improve to a certain extent with the increase of the growth.

In a considerable proportion of cases there is little or no troublesome cough. But if an attack of catarrhal inflammation should occur, the cough becomes especially distressing; and fits of spasmodic cough may be excited from time to time in any case in which a pendulous tumour is liable to get into obstructive position. Occasionally the patient becomes conscious of the presence of some cause of obstruction, and tries to 'cough it up.'

Slight mucous or mucopurulent expectoration may attend the cough: sometimes portions of the growths may be mingled with the expectorated material;[1] and, as already stated, in some exceptional instances, considerable portions and even the whole of the 'new growths' have been got rid of in this manner.

Among the various affections which may give rise to symptoms similar to those thus referred to as caused by the presence of new growths in the larynx, may be enumerated—chronic laryngitis with œdema; spasm of the larynx, from whatever cause; laryngismus stridulus; nervous aphonia; pressure upon the pneumogastrics

[1] It may be interesting, from an historical point of view, to quote the words of Ehrmann, writing in the year 1850:—'Il n'existe, il faut le dire, qu'un *seul* signe certain de l'existence de cette maladie; c'est l'expuition de quelques parcelles du polype.'—*Op. cit.* p. 31.

or the recurrent branches by tumours, aneurisms, &c.; retropharyngeal abscesses; pharyngeal polypi hanging down or projecting into the larynx, &c. It is, however, in the present day altogether needless to discuss in detail the distinctive differences that may or may not be presented by the symptoms in these several affections. In all cases in which time and opportunity are at command the diagnosis may be readily determined by aid of the laryngoscope. In cases, however, in which the symptoms are very urgent, whatever may be their cause, relief must be afforded and safety secured by tracheotomy or otherwise before any full inquiry can be entered upon: laryngoscopic examination may then be made under favourable circumstances at any convenient subsequent period. It occasionally happens, in the case of growths taking origin low down, that they almost disappear under the vocal cords or into the ventricles during inspiration, and only come thoroughly into view during expiration.

It is worthy of note that in some cases, particularly in children, who are difficult subjects for laryngoscopical examination, valuable, if not conclusive, indications may often be obtained by digital exploration. The effort at vomiting commonly excited during the introduction of the finger into the pharynx causes the larynx to rise momentarily, and thus to come within easy reach.

Treatment.—Measures should be adopted for the removal or destruction of all non-malignant new growths in the larynx as soon as practicable after their presence and probable character have been ascertained. For it may be asserted without fear of contradiction that no patient can be considered safe who has in his larynx a new growth of any considerable size—that is to say, unless his safety has been secured by tracheotomy. And small growths, as already stated, are liable to enlarge more or less quickly, and often unexpectedly; and even while still small they may favour the supervention of dangerous inflammation.

In some cases it is absolutely necessary, and in others it may be desirable, to perform tracheotomy before proceeding to any further operative measures. Very many cases, however, have now occurred in which, without tracheotomy, growths have been removed from the larynx, not only with the best ultimate results, but also without having involved the patient even temporarily in any serious risk.

The advisability of performing tracheotomy as a preliminary measure must be determined by the urgency of the symptoms, and the probable difficulties and dangers of the proceedings about to be carried out.

A great variety of different methods has been devised and adopted for the removal of growths from the larynx. They may be divided into those in which the operation is performed by aid of the laryngoscope through the mouth and natural passages, and those in which access is first obtained to the interior of the larynx by means of incisions in the median line through the skin, cartilages, &c.

In deciding upon the course to be pursued, it is necessary in every case to take into consideration not only the size, precise situation, and character of the growth, but also the age, development, and condition of the patient, together with his general and special powers of endurance. If success is not attained by the method first adopted, another may be tried.

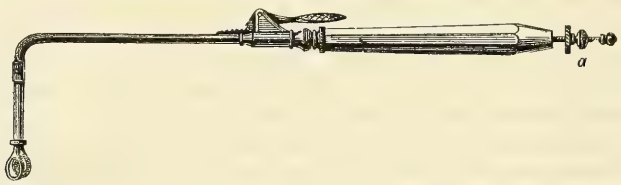
A. *Endo-laryngeal Operations.*

1. *The application of caustics and powerful astringents* to growths in the larynx may be accomplished by the several methods already described (see p. 663); in the case of small isolated papillary growths, such applications, several times repeated, are not unlikely to prove efficacious.

2. Small fibrous, fibroid, and fibro-cellular growths, and small or large papillary growths, may, in many cases, be successfully seized by means of properly adapted *forceps*, and either *torn off* and removed in mass, or so *crushed* as to lead to their destruction. It is always desirable to warm all laryngeal instruments in order to prevent, as far as possible, unnecessary irritation. As a rule, it is not safe to give

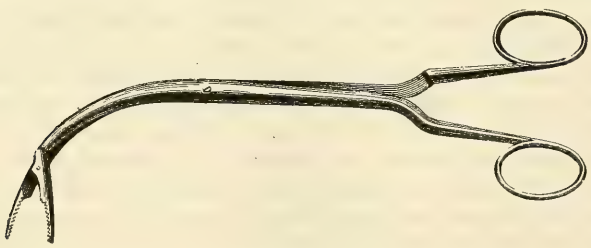
chloroform. In the case of multiple growths, the repeated use of the forceps is often necessary. Portion after portion may be removed either at the same sitting, or during a series of sittings at intervals, according to circumstances. This method is especially advocated by Mackenzie;[1] and the laryngeal forceps which bear his name (fig. 155) are, I believe, the most generally applicable, and therefore the best of all the instruments yet devised for such purposes. They can be fitted with horizontal or perpendicular blades. Forceps made upon the principle illustrated in fig. 156 are also very efficient. Some of these forceps are made to open laterally, and others antero-posteriorly, like those represented in the figure. In some cases ordinary laryngeal forceps, such as those figured and described in the chapter on Foreign Bodies in the Larynx, have been used with perfect success.

Fig. 155.—Mackenzie's Laryngeal Forceps.



3. For the removal of laryngeal growths by *the Wire Snare* it is necessary to employ a slender and appropriately curved instrument carrying a wire loop, which can be quickly and easily drawn home when once it has been made to encircle the growth. The instrument successfully used by Dr. Walker of Peterborough in the first case in which a laryngeal growth was removed from the larynx during life in this country, was a modification of Gooch's double cannula.[2] But the double tube is cumbersome and altogether unnecessary. Gibb's 'Laryngeal Écraseur'[3] is a far more perfect instrument—indeed, nothing could be better adapted for its purpose, unless it be some such modification as that suggested by Dr. George Johnson.[4] These instruments bear a general resemblance in construction and mode of working to Wilde's Aural Polypus Snare, and Hilton's Nasal Polypus Snare; but they are, of

Fig. 156.—Laryngeal Forceps, opening antero-posteriorly.



course, different in shape and more slender. In using this instrument the wire loop is made to encircle the growth, and then pulled tightly home. The growth is then forcibly pulled or twisted from its attachment, and, as a rule, is brought away in the loop. This method is strongly advocated by Sir D. Gibb,[5] and Dr. George Johnson.[6] It is especially applicable in cases in which the growths project in such manner and direction as to render them easily caught, and in which they are soft or pliable in texture, and not very large. Dr. Mackenzie has, however, pointed out the possibility of the wire being displaced, and thus missing the growth. He has devised and successfully used a wire snare concealed in a loop of metal, which can be slowly tightened by means of a cog-wheel turned by the index-finger. Professor Stoerk was

[1] *Op. cit.* p. 114.
[2] See *Lancet*, November 9, 1861, p. 444.
[3] Made by Weiss; see Gibb. *Op. cit.* p. 138.
[4] See *Transactions Royal Med.-Chir. Soc.* vol. li. p. 173 *et seq.*
[5] *Op. cit.* p. 138.
[6] *Op. cit.* p. 173 *et seq.*

the first to use the metal guard; but his instrument has a circular knife in place of the wire, on the principle of the guillotine.

4. *The galvanocaustic method* was first practised by Middeldorpf, and has since been adopted by Voltolini, Türck, Bruns, and others. It has been still more recently recommended by Dr. Reichel of Breslau.[1] This method consists in encircling and cutting off the growth by means of a platinum wire, which is so arranged in an appropriate carrier that when in position it can be intensely heated by means of a galvanic battery with which it is connected. The difficulties of this method are sufficiently obvious, and they, together with certain other practical objections to it, are clearly and forcibly stated by Bruns,[2] after some experience of its use. Its advantages in certain cases are equally obvious; and it would appear to be especially applicable in cases in which single fibrous growths exist, the peduncles of which are too strong to permit them to be safely torn away by means of the snare or forceps. A touch of the heated wire may be sufficient to dispose of small papillomatous growths.

5. *The knife*, properly curved and guarded, or the *laryngeal scissors*, may be used for the separation of firmly-attached growths which may have been seized but cannot be pulled off by the snare or forceps. Such means were adopted in several of the cases successfully treated by Bruns.[3] Several different forms of laryngeal guillotine have been devised. Of these Matthieu's is probably the best. It has been used with success in several cases.

6. *Simple puncture* by the guarded bistoury or some specially contrived instrument (such as Mackenzie's laryngeal lancet) has proved completely efficacious in several instances in which the growths were cystic in character; and in such cases this method may be recommended. If in any case the cyst should fill again, it may be desirable on a second occasion to remove a portion of the cyst wall, or at least to make a more extensive incision than the previous one.

It is scarcely needful to add that all these several methods of removing laryngeal growths require during their execution the guidance afforded by the laryngoscope.

B. *Extra-laryngeal Operations.*[4]

In certain cases in which the growths are numerous, or very large, or single but firmly attached, and in those cases again in which the patients are young, and unable to bear the introduction of instruments through their narrow natural passages, the easiest, most certain, and at the same time the safest method of operating consists in laying open the cavity of the larynx by external incision, and then removing the growths by scissors, écraseur, or galvano-caustic wire. The results of experience[5] encourage the further and more confident adoption of this procedure in special cases. It affords opportunity for the more immediate, complete, and effectual removal of the growths than can be obtained in any other manner. It is by no means difficult of execution, nor does it usually involve any very great risk. Such bleeding as may occur can be readily checked, for all the parts are fully exposed; and freedom of respiration may be secured by the preliminary performance of tracheotomy—if, indeed, this operation have not previously been rendered necessary.

A good illustration of the success attending this method is afforded by the case of a girl, thirteen years of age, under Mr. Durham's care some years since in Guy's Hospital. Tracheotomy had been performed four years previously on account of the urgent dyspnœa

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[1] *Klinische Wochenschrift*, No. li. 1869. Berlin.

[2] *Die Laryngoskopie und die laryngoskopische Chirurgie*, p. 144, *et seq.* Tübingen, 1865.

[3] See Table, *op. cit.* p. 254.

[4] It is worthy of note, that the first recorded operation of this kind was performed in the year 1844 by Ehrmann, who, without the aid of the laryngoscope (not then in use), diagnosed the existence of growths in the larynx from the symptoms and the appearance of portions in the sputa. He was justly so confident of the correctness of his diagnosis, that he boldly opened the larynx by median section, found the growths, removed them, and cured his patient. *Laryngotomie dans un cas de Polype du Larynx*; Strasbourg, 1844. Also *op. cit.*

[5] See especially the excellent treatise of Dr. Charles Planchon, *Faits cliniques de Laryngotomie*; Paris, 1869. In this treatise a large number of illustrative cases are given.

from which she then suffered. On laryngoscopical examination, masses of warty growths were distinctly seen. These were removed by the scissors after exposure of the laryngeal cavity by section through the thyroid cartilage, crico-thyroid membrane, and other structures. Nitrate of silver was freely applied to the bleeding surfaces. The growths had occupied the whole cavity of the larynx. The divided parts were brought together. The patient made a speedy recovery, and the tracheotomy cannula, which she had worn for four years, was removed ten days after the operation. Three or four years after the operation she was in good voice, and no appearance could be discovered of any recurrence of the growths.[1] In two other cases the results have been equally satisfactory.

A remarkable case is recorded by Balassa of Pesth. The patient, a young woman, twenty-one years of age, had suffered from more or less difficulty of breathing, and had been aphonic for more than two years. On laryngoscopical examination growths in the larynx were seen. Balassa laid open the larynx by section through the thyroid cartilage, and removed five portions of new growth. The patient made a good recovery, and her voice returned. Less than a year afterwards, she again lost her voice, and experienced increased difficulty in breathing. Balassa a second time opened the larynx through the thyroid cartilage in the situation of the old cicatrix. Three or four portions of new growth were removed. The patient again made a good recovery; and, as the result, was altogether relieved of her dyspnœa, and regained her voice.[2]

Extra-laryngeal operations, however, should only be attempted after other less severe methods have failed, or when life is in danger from dysphagia or suffocation.

In operations of this kind the thyroid cartilage or the thyro-hyoid or crico-thyroid membrane may be divided after Malgaigne's method. It is desirable to avoid, if possible, cutting through or otherwise damaging the cricoid cartilage.

MM. Prat and Follin have each succeeded in removing tumours from the larynx after having divided the thyro-hyoid membrane and superficial structures by transverse incision.[3] The objections to this method, arising principally from the necessary section of the hyoidean muscles, as well as from the imperfect extent to which the cavity of the larynx is exposed, are sufficiently obvious.

In the case of epitheliomatous and other cancerous growths, it would appear to be worse than useless to attempt removal, without first fully opening the larynx and exposing the whole extent of the morbid structures. Whether any such attempt is justifiable the circumstances of the case must decide. As a general rule tracheotomy becomes necessary sooner or later; and it is probable that, when once the character of the malady is recognised, the earlier the operation is performed the better.

Extirpation of the larynx.—The removal of the entire larynx, including the lower portion of the epiglottis, was first performed by Billroth in the year 1873. It had been suggested as a practicable operation, however, nearly twenty years before this. In 1870 Czerny,[4] by experiments on dogs, proved that the operation might be successfully carried out. In Billroth's case, in addition to the cricoid and thyroid cartilages and both arytenoids, the two upper tracheal rings and the lower portion of the epiglottis were removed. In one case, in addition to the entire larynx, the hyoid bone, and part of the tongue, and both submaxillary glands were removed.[5] The patient recovered from the operation and lived several months afterwards, ultimately dying from a recurrence of the original disease (carcinoma) in the cervical lymphatic glands.

Dr. Foulis of Glasgow[6] was the first to perform the operation in this country. In his case a papilloma had been twice completely removed by extra-laryngeal methods, and, after an interval of nearly sixteen months, had again so increased in size as to necessitate the removal of the larynx. Dr. Foulis was, however, able to save the upper cornua of the thyroid, and a portion of the arytenoid cartilages. This patient, however, died within a year and a half from pulmonary phthisis. Dr. Foulis describes the operation as follows :—'A single vertical median incision from

[1] See *Guy's Hospital Reports*, 3rd series, vol. xii. p. 541.

[2] *Wiener Medizinische Wochenschrift*, November 1868, quoted by Planchon. *Op. cit.* pp. 62 and 79.

[3] Prat, *Gazette des Hôpitaux*, 1857. Follin, *Archives générales*, fév. 1867. Quoted by Planchon. *Op. cit.*

[4] *British Medical Journal*, June 1870.

[5] Langenbeck, *Medical Times and Gazette*, August 1875.

[6] *Lancet*, October 1877.

the hyoid bone to the second ring of the trachea exposes the front of the larynx. The two sides of the cartilaginous box are then freed from the muscles quite back to the gullet. Up to this point the larynx is not opened, and no blood can escape into it. The larynx is then separated from the trachea by a transverse cut, the trachea having been previously transfixed and held forward with a sharp hook. A large syphon tube of vulcanite, fitting the trachea, is put in to keep out the blood and permit free respiration. If this is neatly and carefully done, there is no need of preliminary tracheotomy and use of Trendelenburg's tampon, which has the disadvantage of largely increasing the length of the wound; while in Billroth's case, at all events, it was not found to facilitate matters to any extent. If there is much oozing, something may be done by adopting Rose's plan of lowering the head of the patient, so that the flow of blood is in the direction away from the trachea. The upper and posterior attachments of the larynx are next cut, care being taken in separating the gullet and pharynx to keep the edge of the knife close to the cartilages so as to avoid button-holing the gullet. It might be well to mop the raw surface out with a solution of chloride of zinc (30 gr. to the ounce) at the close of the operation; but it is not advisable to irrigate the wound in any way afterwards, on account of the gulping and "irritation which it sets up." When the wound has fairly healed, Gussenbauer's [1] artificial vocal apparatus should be introduced. In Billroth's case this was introduced, on the twenty-first day the patient being able to speak in a loud monotonous artificial voice. Dr. Mackenzie [2] gives a very valuable table of the cases hitherto recorded. It appears that out of nineteen patients who had been subjected to entire or partial removal of the larynx, nearly half died within the first fortnight. In seven others, recurrence of the disease took place at periods varying from three to ten months. These results are not encouraging, for there is certainly a very great immediate risk, and it is, moreover, at present difficult to rightly estimate the chance of life without resorting to operation.

Trendelenburg's laryngeal tampon consists of an india-rubber belt which encircles the lower end of the tracheotomy tube. The belt is inflated (but not too fully) by means of a fine silver tube soldered to the outside of the cannula, which is free at one end, and, by the other, communicates with the belt. To the free end is attached a few inches of elastic tubing, terminating with a stop-cock. When the belt is inflated it is even with the surface of the cannula. Dr. Semon has greatly improved this arrangement by placing the fine tube *within* the cannula. This is a most valuable instrument in preventing blood entering the trachea during severe operations on the larynx, pharynx, or tongue.

Sensory Affections of the Larynx.

The mucous membrane of the larynx may lose its natural sensibility, either as the result of central disease or of mischief affecting the fibres which go to form the superior laryngeal nerves. This condition is chiefly met with in patients recovering from diphtheria, and associated with diphtheritic paralysis. In some cases the sensibility of the epiglottis and vocal cords is so completely lost that the contact of the laryngeal probe with the mucous membrane covering these parts, produces neither sensation nor reflex movement in the larynx. This *anæsthesia* may be incomplete, the patient in these cases feeling the contact of the probe; and it may, moreover, affect one or both sides of the larynx. Difficulty of swallowing, especially liquids, is often experienced; and under these circumstances food may enter the air-passages and set up irritation, and thus produce serious and even fatal pulmonary mischief.

In other and rarer cases the anæsthesia is due to bulbar paralysis, which leads to

[1] This instrument consists of two portions—a tracheal cannula, and an ascending stem. The stem is first introduced, and, through its mouth, the cannula. A groove in this allows the introduction of a vibrating reed. Dr. Foulis has improved the original instrument; and Heine has, by means of screw mechanism attached to the reed, permitted its removal to one side when the patient is not speaking—an arrangement which gives the freest supply of air during ordinary respiration.

[2] *Diseases of Throat and Nose*, vol. i. p. 344.

a fatal termination as surely as the diphtheritic form of disease, in a few weeks, terminates in recovery.

In the *treatment* the greatest care should be taken to prevent food accidentally passing into the larynx. If the loss of sensibility is confined to one side, the patient may possibly be able to swallow when lying on the sound side. If both sides are affected, it will be necessary to feed the patient with the œsophageal tube, or for a time by means of nutrient enemata. The surgeon should bear in mind the possibility of the tube entering the larynx, owing to the lessened sensibility of the parts. To prevent this accident it should be guided as far as possible by the finger; and if there should still be any doubt as to its position, as Mackenzie suggests, the patient should be desired to produce a vocal sound before any food is injected. The daily use of the galvanic current by means of the laryngeal rheophore, and the administration of tonics, especially iron combined with strychnine, will be the best treatment.

A morbidly *increased sensibility* of the larynx (*hyperæsthesia*), and in some cases *neuralgia*, may follow attacks of laryngitis. These changes from the healthy sensibility of the larynx may sometimes be traced to hysteria, or to the prolonged use of the voice, whilst the neuralgia seems chiefly to result from cold. In these cases the larynx is abnormally irritable and sensitive, the patient complaining of a dry, pricking, or burning sensation, or at times even believing that some foreign body is lodged in the throat. These symptoms are not dangerous in themselves, although often long persistent.

The *treatment* should be guided by the general condition of the patient. Change of air, if possible, sea bathing, suitable mental occupation, with local astringent applications, are usually in the long run successful. Iodide and bromide of potassium have each been advocated, and, in those cases in which rheumatism is suspected, with undoubted benefit.

Motor Affections of Larynx.

Laryngeal paralysis may result from disease of the nervous system, or may be less commonly due to some local change in the muscles of the part. Hence it is either *neuropathic* or *myopathic*. In diagnosing these conditions it is necessary to exclude those cases in which muscular movement is impeded or arrested simply from mechanical causes, such for example as a swollen condition of the inter-arytenoid fold or anchylosis of the crico-arytenoid articulations.

Neuropathic Paralysis.

When the paralysis arises from disease of the nervous system (when it is neuropathic) the cause may be traced either to central disease involving the motor nucleus of the pneumogastric in the floor of the fourth ventricle, or the trunk of the nerve itself; or its laryngeal branches on one or both sides may be implicated.

When disease affects the motor nucleus of the pneumogastric, the laryngeal symptoms are sooner or later associated with others which clearly point to central mischief. The muscles of the soft palate, tongue, or face are commonly involved, and in addition there may be hemiplegia. A certain number only of the fibres which go to form the nerve may be affected; sometimes those which ultimately form the recurrent nerve, or even those fibres which supply a single muscle, may alone be involved.

The laryngeal symptoms vary in a corresponding degree. Hence all the muscles on one side may be paralysed, or only the abductor or adductor. The voice is commonly affected, and if both abductors be paralysed there is marked stridor during inspiration; but these symptoms will be considered more fully in discussing the paralyses due to injury or disease of the laryngeal nerves.

When the whole trunk of the nerve is affected, the laryngeal symptoms vary according to the seat of the disease. Thus, for example, if a tumour involves the entire trunk of the nerve at its exit from the cranium, both the superior and the recurrent laryngeal branches will be implicated, and there will be complete paralysis of the muscles of this side. If, on the other hand, destruction of the functions of the nerve takes place below the origin of the superior laryngeal, then only those

muscles supplied by it will be affected, the depressors of the epiglottis and the crico-thyroid muscle escaping.

If, again, certain motor fibres in the trunk of the nerve remain uninjured, the muscles to which these are destined will of course retain their function. It appears, therefore, that the lesions involving the trunk of the pneumogastric produce a series of laryngeal symptoms almost identical with those which result from disease of its superior or recurrent branch. The functions of the nerve may be wholly or partially destroyed, as the result of pressure from tumour, or the sac of an aneurism, enlarged or suppurating glands, or bronchocele. It might, moreover, be injured during operations on the neck, or during ligature of the carotid artery.

The *superior laryngeal* nerve, as already stated, is occasionally affected as the result of diphtheria. More rarely the paralysis is due to other causes, such as pressure resulting from enlarged cervical glands, or direct injury to the nerve itself.

In these cases motor paralysis is superadded to anæsthesia; the depressors of the epiglottis and the crico-thyroid muscle are involved. The epiglottis, therefore, is not properly depressed during deglutition, and food easily enters the larynx. Paralysis of the crico-thyroid muscle may usually be detected by placing the finger over the muscle, and noting the absence of contraction during attempted phonation.

When both sides are affected, the vocal cords are relaxed and have a wavy outline. A slight flapping of the central and most relaxed portion of the cord has been noticed during respiration; where one muscle only is affected, the vocal cord on that side 'remains on a higher level than its fellow.' The voice is commonly lost in these cases. The chief danger seems to result from food passing through the glottis and setting up pulmonary mischief. When, however, one side alone is affected the danger from this cause is much lessened.

The *treatment* must be carried out with the utmost care in order to prevent particles of food reaching the air-passages. The patient must be fed with the œsophageal tube. Galvanism should be used, and tonics combined with strychnia administered. If any local cause can be detected, the possibility of its removal should at once be considered.

The *recurrent laryngeal* nerve may be affected on one or both sides. Complete bilateral paralysis is, however, uncommon; it has been already seen that this condition may be the result of central disease in the medulla, or that it may be due to compression of the trunk of the pneumogastric itself. The recurrent nerves alone are, however, occasionally involved in a cancerous growth of the œsophagus or elsewhere, or they may be compressed by an enlarged thyroid gland or the sac of an aneurism. The symptoms, in whatever manner they may be produced, are by no means uniform; and this variation appears to result from the paralysis being in many cases incomplete, owing to the escape of certain fibres which are thus able to perform their motor functions.

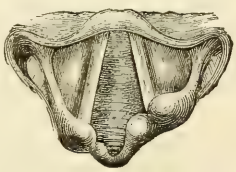


Fig. 157.—Paralysis of Left Recurrent Nerve. (Mackenzie.)

If the entire trunk is involved on both sides, the vocal cords remain passive and immovable in what has been well termed 'the cadaveric position;' midway, that is, between the position of phonation and that of deep inspiration.

There is no dyspnœa; but, the muscles of the larynx acting no longer as a barrier to regulate the passage of air from the chest, the patient can neither expectorate nor use his voice properly, and all his attempts are accompanied by great efforts owing to the waste of expired air.

In incomplete paralysis the abductors are most commonly affected, and this appears to be the case whether the paralysis is on one or both sides. Several ingenious explanations have been given to account for this curious fact, but none are entirely satisfactory. If, then, the abductors alone are affected, the adductors acting without their opposing muscles, the vocal cords remain near the middle line; and if, on the other hand, the adductors be affected, the glottis remains widely open. The condition of the voice depends to a large extent on the implication of the tensors

(crico-thyroid and thyro-arytenoid). When the abductors are alone affected dyspnœa is commonly present.

If the paralysis is complete on one side and incomplete on the other, the voice, although greatly modified, is not entirely lost. After a time the affected muscle becomes atrophied.

The danger in these cases depends to a great extent on the seat and the cause of the mischief, but the laryngeal complications are sometimes so severe as to necessitate tracheotomy. In the treatment, therefore, the remedies must be selected according to the exigencies of each case. When the paralysis is unilateral it is commonly on the left side; the left recurrent, from its long course around the arch of the aorta, being especially liable to pressure from aneurismal and mediastinal tumours. The right nerve, however, as is well known, comes into close relation with the apex of the right lung, and therefore may be affected by disease occurring at the apex of this lung.

If the paralysis be complete, the cord on the affected side remains in the cadaveric position, the healthy cord moving towards it and even passing beyond its normal limit. In cases of one-sided paralysis, the voice is usually much altered and sometimes even lost, and speech is effected when possible with much greater effort than before. There is often considerable stridor, due apparently to the adducted position of the cord.

The prognosis must depend on the cause of the paralysis and the amount of dyspnœa. In the treatment tracheotomy may be required.

Myopathic Paralysis.

The term Myopathic Paralysis may be applied to those cases in which, as far as can be ascertained, there is neither nerve lesion nor any mechanical cause to which the arrested movements can be attributed. What the exact changes are, and whether they lead to subsequent disease in the nervous system, it is not necessary here to discuss, but undoubtedly fatty degeneration and atrophy of the muscular fibres have been observed after death. It is probable, however, that many so-called myopathic cases may be in reality those of true paralysis which have not been recognised as such during life, or even after death in the post-mortem room.

The *abductor muscles* seem to be those chiefly affected; male adults being most liable to this disease. Long-continued use of the voice, exposure to cold, injuries resulting from swallowing liquids too hot or too cold, the irritation set up by the passage of a bone or other hard substances along the lower part of the pharynx—each and all have been regarded as the cause of this form of paralysis. It will be readily seen how liable these muscles are to injuries from such causes, lying as they do between the thin mucous membrane and the posterior surface of the resisting cricoid cartilage, and forming the anterior wall of the canal just at its narrowest and least distensible part.

The *symptoms* are usually well marked; expiration is easy, inspiration difficult, producing stridor and often great dyspnœa. The adductors still retaining their power, the rima glottidis is much contracted and remains so during inspiration. The voice is usually somewhat husky. The only conditions with which these cases are likely to be confounded are those of spasm of the adductors; but the temporary and paroxysmal nature of this affection, and its disappearance during sleep or under chloroform, will as a rule be sufficient to separate the two conditions.

In the *treatment* the impeded respiration indicates tracheotomy as the only method likely to give immediate relief. If syphilis is suspected, specific remedies should of course be administered. Galvanism may also be employed.

Paralysis of *one abductor* may occur with corresponding modifications of the symptoms.

Both *adductors* may occasionally be affected, producing loss of voice. This is especially liable to occur in young women, and in them it may commonly be traced

to hysteria. In such constitutions simple laryngitis or even slight congestion of the throat are very likely to be followed by aphonia.[1]

The laryngoscope shows that in attempted phonation the vocal cords are not properly approximated. Although these patients cannot speak by a voluntary effort, yet sound is produced in the reflex act of coughing or sneezing.

A cure can usually be brought about; but it is of the first importance to remove as early as possible any remaining inflammation or congestion, otherwise the aphonia may continue for a very long period. Pigments of iron and of nitrate of silver, or taninn and glycerine, are amongst the most useful astringents, and one of these should be applied daily with the laryngeal brush. The application should not under ordinary circumstances be suddenly omitted, but should be used at longer and longer intervals as the case progresses.

Electricity is also of great value in many cases when the local symptoms have been removed; for it not only restores the voice at the time, but has an excellent moral effect over patients who believe they cannot speak. *One adductor* only is occasionally at fault.

Impairment or Arrest of Muscular Movement from Mechanical Causes.

It is unnecessary here to do more than mention the likelihood of tumours in the situation of the glottis interfering with muscular movement. The swelling and thickening of the inter-arytenoid fold, in like manner as the result of syphilitic or tubercular disease, is so obvious that any impairment of movement under these conditions would at once be attributed to its proper cause. But there are cases hitherto scarcely well understood in which the arrest of movement is due to disease affecting the crico-arytenoid articulation itself. Dr. Felix Semon[2] has especially called the attention of the profession to this often obscure and hitherto neglected cause. He regards 'every form of stiffness of the crico-arytenoid articulation which is produced by mechanical causes, as an anchylosis of this joint, and distinguishes two forms—namely, first, the true anchylosis, in which the stiffness is produced by intra-capsular disease; and, secondly, the spurious or false anchylosis, in which extra-capsular changes lead mechanically to impairment of the functions of the joint. In some cases true anchylosis is a consequence of a long-existing spurious one. Luxation of the crico-arytenoid articulation means a displacement of the arytenoid cartilage from the articular surface of the cricoid; in some cases both anchylosis and luxation are present at the same time together.'

The joint may be fixed in any position into which it can be naturally moved, or, as a result of cicatricial contraction, it may be drawn across the median line. The anchylosis may be either unilateral or bilateral, but it is not in the latter case necessarily symmetrical. Tumefaction is often, though not always, present; and in true anchylosis may be entirely absent. Again, it may be complete or incomplete, or accompanied with luxation, or this alone may be present.

Dyspnœa is a very constant symptom. The voice may be normal; but it is more likely to be affected, and in some cases is entirely lost. The diagnosis during life is often extremely difficult, and on this head Dr. Semon writes:—'The diseases with which anchylosis and luxation of the arytenoid cartilages may be most easily confounded are of course, above all others, nervous and myopathic affections of the larynx. There is no doubt that nervous paralysis is the most frequent cause of motor impairments in the larynx; and I wish to say distinctly that always in the first place, unless there are such decisive symptoms as tumefaction and luxation, we must think of a nervous paralysis, if we observe laryngoscopically a motor impairment. If, however, a careful consideration of the case, and a close physical examination of the patient, fail to give us any clue as to the existence of any such nervous

[1] This form of paralysis has been also attributed to rheumatism and over-use of the voice both in speaking and singing.

[2] *Medical Times and Gazette*, vol. ii. 1880.

disorder, we shall, especially if there is a history of one of those diseases enumerated [1] preceding the laryngeal trouble, have to think of the possibility of an anchylosis of this articulation. Very unusual position of the immobile arytenoid cartilages and corresponding vocal cord; absolute immobility; signs of previous ulcerative diseases; abnormal distortion of the mucous folds; and, above all, tumefaction at the basis of the immovable arytenoid cartilage, will, of course, much foster such an idea. The possibility of a combination of nervous and mechanical impairment must not be overlooked, and, in such a case, the question is which has been the primary one. Typhoid fever, syphilis, or diphtheria, for instance, may lead to nervous paralysis or to anchylosis as a result of ulceration; and, on the other hand, the anchylosis may supervene on the paralysis, &c.'

Treatment.—It may be necessary to dilate [2] the stricture, or first to perform tracheotomy in those cases in which respiration is seriously interfered with. It is of course desirable, when possible, to endeavour to prevent the anchylosis, and this is best accomplished by rest of the parts.

Spasm of the Glottis.

Spasm of the glottis is especially liable to attack children during their first dentition, and is often in severe cases associated with spasmodic contraction of some of the muscles of respiration. The diaphragm and intercostal muscles are very commonly affected. It also occurs in the adult, women being more liable to these attacks than men. As already stated, it may be the result of direct laryngeal irritation, but it is often a purely nervous affection.

In *children* the disease is not common. By far the larger number of cases occur amongst male children during the first two years of infant life between the ages of six and eighteen months. It is said that children of the poor are much more liable to be affected than those of the rich, but certainly cases are found amongst the wealthier classes. It seems to be most frequent amongst scrofulous children and those who are the subject of rickets. Dr. Gee,[3] who has paid much attention to this disease, believes that season has a marked influence in the production of the disease, having observed most of his cases during the first six months of the year. Children during winter and early spring are often cooped up in unhealthy dwellings, and one of the results of this appears in a condition of the nervous system especially prone to laryngeal spasm. It has been pointed out that the attack often comes on at the time of weaning, being perhaps in many cases induced by the improper use of farinaceous and indigestible food. Amongst the exciting causes should be mentioned teething, and the irritation produced by improper food. An attack sometimes comes on apparently from the simple act of sucking, and crying occasionally has the same effect.

The *symptoms* are usually unmistakable; they are sudden in their onset, and may take place without warning. On inquiry, however, it will often be found that the child has been ailing for some days. The fit often takes place at night; it is marked by a series of short, stridulous inspirations with increasing intervals, accompanied by great dyspnœa; then the glottis is spasmodically closed, and for a time respiration ceases. In this condition the child may die presenting all the symptoms of asphyxia. More commonly, however, the spasm passes off, air again enters the windpipe, and the little patient recovers from the storm of spasm which has affected both the glottis and the diaphragm, and the danger for the time is over. In severe cases some of the muscles of the hands and feet are affected during the fit. The least cause often produces another paroxysm, or it may not occur again; but there is great variety in the severity and frequency of the attacks.

Treatment.—During the attack the child should be raised, and cold water should be dashed upon the chest and face. At the same time, if it be possible, it should be placed in a warm bath. Chloroform is a very valuable remedy in cutting short the

[1] Typhoid fever, Variola, Syphilis, Diphtheria, Phthisis, and Gout.
[2] Schroetter's hollow bougies are recommended for this purpose.
[3] *St. Bartholomew's Hospital Reports*, vol. iii. p. 104.

spasm, but it must be administered with great care and under proper supervision. After the fit is over, it is important to clear the intestinal canal of any possible source of irritation; for this purpose grey powder alone or mixed with rhubarb is useful. Musk has been successfully used by Dr. Mackenzie. He suggests the following formula: Moschi gr. jss., Sacch. Alb. gr. ij., Pulv. Acaciæ gr. ij., Syrupi Aurantii Flor. ♏ xx., Aquæ ad ʒj. Chloral, if the fit occurs at night, is a valuable remedy.

In the after treatment bromide of potassium has been highly recommended. It is important to attend to the gums, especially if there is any possibility of a tooth being the cause of the irritation. The diet should be most carefully regulated. Farinaceous or other food likely to disagree should on no account be permitted. The clothing of the child should be warm and light, and it should, when possible, be placed in a well-ventilated apartment.

In *adults*, women are more liable to be affected than men. The disease has commonly been attributed to hysteria, and sometimes takes place in phthisical patients, or may happen apart from any discernible cause. The attack closely resembles the laryngismus of children, but is very rarely if ever fatal if we exclude those cases which have their origin in some organic mischief. The laryngeal appearances beyond those due to the spasm are not marked. The parts may appear indeed quite normal; but more commonly there is slight congestion.

Arthur E. Durham, 1870.
Arthur Hensman, 1882.

DISEASES OF THE INTESTINES.

Abdominal Abscesses.

AN abscess which originates in the anterior abdominal wall, in the sub-peritoneal cellular tissue, in the region of the loins, or in the pelvis, and is totally unconnected with disease of bone, or with ulceration of the bowels, is not a very common occurrence; but we occasionally meet with such a case, and it is requisite to consider its peculiarities and treatment.

An abscess originating in the substance of the muscular parietes is most frequently the result of a bruise, and may be treated as abscess in any other position. But one commencing in the cellular tissue of the loin, or iliac region, is generally obscure in the commencement; frequently produces much constitutional disturbance in its progress; and is very often fatal in its results. Abscesses which occur in these situations are sometimes slow in formation; but in some instances increase with great rapidity, and if not opened early may acquire a large size within a week or ten days. According to the rapidity of their progress will be the acuteness of the symptoms which accompany them. They occur in children as well as in adults. When situated in the pelvic region they may be mistaken for psoas abscess dependent on diseased vertebræ; or some kind of tumour growing in the cavity of the abdomen; or, in children, from the resistance of the abdominal and psoas muscles and the drawing up of the thigh on the belly, commencing disease of the hip-joint might even be suspected, if the conditions be not particularly examined into.

A very sickly child was admitted into the Hospital for Sick Children, under the care of Sir W. Jenner, with a large prominent roundish swelling on the left side, between the region of the kidney and Poupart's ligament. There was very little indication of pus, or fluid, in the swelling; its shape and consistence conveyed the impression that it might be a malignant growth. As some doubt existed as to its character, a fine trocar was passed into it by the writer, and some thick pus immediately escaped through the cannula. A small opening was then made through the parietes into the abscess, which allowed the free escape of pus. The child very shortly recovered. A child was admitted into St. George's Hospital with much swelling, and great tenderness about the left iliac fossa: the thigh was bent on the body, and kept drawn up; any attempt to extend it was attended by great pain; so much so, that it was impossible, on account of the struggling and crying of the child, to make out the extent or the seat of the mischief. Chloroform was therefore administered; under its influence the thigh was readily extended, and the mischief found to be confined to the iliac fossa. Here was a swelling of some extent, and all the tissues over it thickened and hardened; the skin was darker coloured and more red than natural. Though fluctuation could not be detected, a small incision was made over the most prominent point, and cautiously extended to some depth; but, as no pus escaped, exploration was not carried further, and a poultice was ordered to be applied. On the second day, a sudden flow of pus took place through the wound; relief to all the urgent symptoms followed; and the child recovered shortly.

Acute and large abscesses occur in the sub-peritoneal cellular tissue about the region of the ovaries after the period of child-birth. For an account of them, and their treatment, we must refer the reader to Vol. I. pp. 107, 108.

Abscess of the abdominal region is often connected with an aperture the result of ulceration of the alimentary canal, either of stomach or intestine. Such an abscess may arise from perforation of the bowel, the result of simple ulceration; or the lodgment of any foreign body in the intestine; often from ulceration set up in the gall-bladder by a gall-stone; or from stricture of the intestine; and not unfrequently from some cancerous disease of the alimentary tube.

When such an abscess occurs, its contents will generally consist of pus mixed

with fæces; but occasionally the opening in the bowel may be so small, that very little of its contents have escaped; sufficient, however, to set up the secondary mischief. When such an abscess is opened, the escape of mere pus alone does not justify an opinion that the bowel neither is, nor has been, implicated. It will happen occasionally, some days after clear pus has been discharged from the opening, that fæculent matter is observed for the first time to be mixed with the discharge. The contraction of the walls of the abscess may probably disturb some of the former attachments of the intestine, and thus facilitate the renewal of an escape of its contents. The discharge in most cases, especially at first, is most offensive.

Abscesses connected with the bowel cannot be said to follow any definite rule, either as to symptoms, rate of progress, or termination. They may be obscure in their commencement, and in their progress, or marked by violent pain; while the medical attendant may be daily watching for an opportunity to give exit to pus at some favourable point, the swelling may suddenly subside, and disappear by evacuating the contents, through some fresh opening, into the bowel, the pus being discharged per anum.

When of an acute character, the symptoms of a 'fæcal abscess' are very marked. Sudden pain is referred to the part affected, often of a very severe character; constipation is often the forerunner of the attack, or accompanies it. The pulse and tongue sympathise early in the mischief; the former becomes rapid; the latter loaded and creamy, and soon dry and brown. There is often great anxiety and restlessness; much thirst, and a hot dry skin. There is very frequently, early in the attack, distinct fulness of the part implicated; and, in addition to extreme tenderness and an intolerance of pressure, general indications of diffused peritoneal inflammation. The most frequent seat of such abscesses is the region of the ilio-cæcal valve—the right iliac fossa; but they may occur in any part of the abdomen.

Sometimes the formation of pus is so rapid, and the mischief in the peritoneal cavity is so general, that the patient dies within a few days of the first symptom of pain. Mr. ——, late House-Surgeon of St. George's Hospital, while walking in Hyde Park, was suddenly seized with excruciating pain about the right iliac fossa. Though but a very short distance from his lodgings, he was obliged to be carried home. When seen by the author in the evening, there was intense pain in the right iliac region, with a certain amount of fullness, and great tenderness on pressure. The skin was hot; the pulse rapid, and there was great anxiety of countenance. The symptoms were in no way relieved by the treatment prescribed in consultation with the late Dr. Bright. The case proved fatal in a few days. On examination after death, a large abscess was found to occupy the right iliac fossa; the boundaries were formed by adhesions of the intestines and the parietal peritonæum. The contents were pus and fæces. The appendix cæci was found ulcerated through at its extremity. No solid substance could be found, to account by its pressure for the ulceration.

This perforation was probably the result of ulceration of the bowel commencing in the mucous membrane, and subsequently making its way through the muscular and peritoneal coats, such as is often known to occur in the later stages of enteric fever. The author has seen other cases in which death has followed even more rapidly; sudden collapse with acute pain in the lower parts of the abdomen, with all the symptoms of acute peritonitis, followed by death in two or three days.

It is desirable to note that when abscess is the result of an ulcer perforating the wall of the cæcum, much will depend on the exact seat of that ulcer; viz. whether it be in the part covered by peritonæum, or on the posterior surface where the intestinal wall is in contact with cellular tissue. In the former instance, perforation is rapidly fatal as the immediate cause of acute peritonitis: or adhesions of the opposed peritoneal surfaces may have occurred prior to the perforation, and the abscess become limited by such adhesions, and after a time present externally; the patient then has more chance of recovery after the evacuation of the pus. In the other instance, in which an abscess is the result of perforation of the posterior wall of the intestine, and the escape of fæcal matter into the cellular tissue, the abscess is less apt to be limited; and matter often burrows in a variety of directions.

A woman admitted to St. George's Hospital, under the author's care, had extensive suppuration and numerous sinuses with various openings in the right groin and on the outer surface of the right ilium. These were freely laid open, but she gradually sank exhausted. On examination after death, a circular smooth-edged small opening was found in the wall of the

posterior surface of the cæcum, communicating with a large abscess in the right iliac fossa, with numerous sinuses running in various directions. The ulceration appeared to be due to an attack of fever.

In a patient, a lady under the care of the author, an abscess which had apparently commenced in the cellular tissue of the pelvis opened into the rectum, bladder and vagina: and in another case openings existed between the abscess, bowel and vagina. In both instances recovery took place after free incision, so as to allow of ready escape of pus. Some time elapsed before the various openings closed, yet ultimately all healed, and left no trouble behind.

Occasionally an abscess in this neighbourhood is much more tardy in its progress; and although matter continues to collect, the patient, having passed over the first acute stage of the attack, may soon improve in health and appetite; the general tenderness of the abdomen, or distension of the bowels—should either have existed—commences to subside; and a local swelling remains in some portion of the abdomen, marked by external fulness, and often by a well-defined surrounding wall. The skin over this part becomes more red and shining than that of the immediate neighbouring surface; then darkens in colour, and becomes thinner at one or more spots; and either ulcerates or is punctured, when pus readily escapes.

It is safe and judicious treatment to open such an abscess, as soon as it may be suspected to have formed, and to be within reach of the knife. If the incision be delayed until matter makes its approach towards the surface, it will generally happen, during this process towards self-liberation, that the pus works its way in several directions; it has been so long kept back by the resisting action of the abdominal muscles and fasciæ, that it has burrowed wide and deep: so when the external opening has been long postponed, by nature or the surgeon, we find, in addition to the suppurating cavity in the iliac region, that the abscess has passed under Poupart's ligament and among the abductor muscles of the thigh, or deep into the pelvis, and may present itself in the perinæum or have opened into the rectum or vagina. Abscess in the *left* iliac fossa, independent of cancer, is more rare, but the author has lately had under his observation a case in which an abscess appeared to have commenced a little above Poupart's ligament in the left inguinal region, from some cause not readily determined, and this gave rise to perforation of the sigmoid flexure, followed by an external fæcal fistula. We can never define what bed these abscesses may form for themselves, or how, when, or where they will discharge their contents. If one be opened late in the progress of the case, long sinuses will often be found, which lead from the opening in the abdominal wall to the surrounding parts, and thus render the ready escape of matter difficult. Under such circumstances, after a time, other collections of matter point, either in the groin, in the thigh, or about the ischiatic rami. Many a patient will, however, sink soon after the opening of a fæcal abscess; not only has he to contend against the effects of profuse discharge, but he has also the extra evil of a too early and free escape of intestinal contents from the artificial aperture.

Notwithstanding the severity of such cases in their general aspect, and the frequently fatal results they entail, we occasionally find a patient gradually recovers after he has endured the opening of a great number of consecutive abscesses; the sinuses slowly contract; the discharge diminishes by degrees, and ultimately ceases; and the orifices of the abscess cicatrise one by one. The patient probably recovers only with a crippled limb. The suppurative action usually damages the psoas and iliacus, and often the adductor muscles to such an extent, that the movements of the thigh are subsequently restricted, sufficiently to prevent the limb being extended to its natural limit.

The general treatment of this class of cases is not to be laid down as simple, nor conveyed in a few words. It depends entirely on the course of the case.

In the early stage, *i.e.* of pain, constipation, and fever, constitutional measures and local treatment must be combined. Opium internally, and hot fomentations, perhaps leeches, externally, are usually most beneficial at first. Opium may be given in full doses, and often repeated. It may occasionally be considered requisite to combine with it small doses of calomel, but this should be prescribed with much caution. Purgatives, as a rule, should be strictly avoided. Under the influence of opium alone the bowels will act as early as their condition will permit; and quite soon

enough to answer nature's purpose, *if they will act at all*, without the aid of purgatives.

When the patient survives the shock of the attack of inflammation, so soon as matter is suspected, the part should be explored, and, if possible, the pus let free. Under the influence of an anæsthetic alone, can a satisfactory examination be made, in a case such as we are now considering; and we would under all conditions which indicate, though they do not absolutely prove, the presence of pus, urge the use of ether or other anæsthetic, that a thorough examination may be instituted, and exploration made if deemed advisable.

Great attention and care in treatment are necessary, as soon as the pus has an outlet, with strict cleanliness to prevent excoriation from the discharge, and also to avoid bed-sores. As the discharge is usually extremely offensive, the chamber may become insufferable, if not constantly and carefully ventilated. A free use of disinfectants is requisite in the room, as well as in the local dressings. A constant and liberal supply of nutritious food and stimulants are necessary to meet the wasting and lowering effects of profuse secretion from the abscess-walls. It is often surprising how much wine patients require, and will take with advantage under these conditions. The bowels must be carefully watched; they are often apt to become relaxed, and diarrhœa, if unchecked, may soon carry off the patient. If collections of matter should point in other parts, they ought at once to be let out; or if superficial sinuses lead from one abscess to another, they should be laid open.

The usual conditions found after death, in cases of fæcal abscess, are general adhesions of the intestines and viscera in the immediate neighbourhood; some portions of which may form the boundaries of the abscess-wall. The communication with the intestine is generally very clear; often several may be observed; but when more than one exists, the greater number are commonly the result of ulceration *from* the abscess *into* the gut.

Most commonly the mischief which produces fæcal abscess, independent of cancer, arises near the ileo-cæcal valve; ulceration of the appendix is one of the most frequent causes.

In the 'Transactions of the Pathological Society' (vol. vii. p. 210) is recorded a case in which perforation of the cæcal appendix was occasioned by the impaction in it of an intestinal concretion. Another case is detailed (vol. xii. p. 85), in which a fistulous orifice in the abdominal parietes opened into a circumscribed cavity, which communicated with the interior of the colon and duodenum, and indirectly with the gall-bladder. This was probably the result of a gall-stone ulcerating into the duodenum, and accidental rupture of the colon.

Fæcal abscesses and fæcal fistulæ occur in other parts of the abdominal wall; they are most frequently connected with the large intestine, and are generally the result of some cancerous obstruction attended by ulceration of the bowel above, which, extending to the integuments, allows a partial escape of fæces.

A case of fæcal abscess and fistulæ communicating with the cæcum, caused by cancerous disease of the large intestine, is recorded in the 'Transactions of the Pathological Society,' vol. i. p. 265; another, of abscess in the abdominal walls in connection with cancer of the stomach, vol. xi. p. 122; and a third, of fistulous openings through the abdominal parietes communicating with the transverse colon and stomach, the result of cancerous disease, vol. viii. p. 221.

The treatment of fæcal fistulæ dependent on cancer does not call for much remark. The patients often linger much longer than might be expected, provided they can take plenty of nourishment; but they often succumb much more rapidly than is anticipated by those in attendance; it is therefore best to warn the relatives of the sufferer of the possibility of sudden collapse when such disease exists.

Intestinal Obstructions.

The causes of intestinal obstruction are various; its occurrence is fraught with much danger, but too often the forerunner of death; its symptoms are severe and distressing; its diagnosis is too frequently obscure; and its treatment uncertain, and often unsuccessful; the consideration, therefore, of such an important subject as the

pathology and the symptoms of intestinal obstructions, and the measures to be employed for their relief, is one of very great importance, and demands most careful investigation.

In entering upon an inquiry beset with so many difficulties, it has appeared to us a very important point, at the outset, to endeavour to classify the causes of obstruction, so that, in some measure, we may be able to determine, according to the symptoms, whether the obstruction depends on an acute strangulation entailing great and imminent danger to life; or on a slowly altered condition of the intestine itself, or of the adjacent tissues. Under the first condition the treatment must be decided; and to prove effective, must be early applied. In the second, there is generally more time to consider the prospects of life, and the advantages of interference. In the first, without prompt and entire relief, death generally follows rapidly in the wake of the onset of the symptoms. In the second, while we are calculating our measures, the symptoms may even subside; and their sudden cessation be followed by perfect recovery.

We therefore propose to divide the causes of obstruction into—first, those we may term sudden; such as are productive of acute and rapidly fatal results, if not presently relieved; and, secondly, those more slowly acting; productive of symptoms, chronic when compared with the first; and such as sometimes subside with the aid of medicine alone, or even occasionally without it.

Those which generally produce most acute symptoms, early in their attack, sudden in their nature, and, if not relieved rapidly, fatal in their results, comprise,

1. Congenital strictures or malformations.

2. Foreign bodies impacted in the intestines, and introduced through the stomach; originating in the gut from particles of indigestible food, &c., or escaping by ulceration from the gall-bladder.

3. Twisting or 'dislocation' of the bowel—most frequently observed in the large, but often in the small, intestine.

4. Loops, formed by bands of false membrane, adherent at both extremities; by diverticula, adherent by their apices to some portion of the viscera or abdominal wall; or by the fimbriated processes or other portions of the viscera contracting adhesions, so as to form rings or apertures for intestine to become entangled in—all these usually the result of peritoneal inflammation.

5. Mesenteric pouches, foramen of Winslow, or 'thickened peritoneal sheaths,'[1] the result of old herniæ.

6. Invagination, often caused by worms, intestinal polypi, &c.

It is hardly necessary to mention that all forms of external hernia are excluded in this consideration.

The more slowly acting processes productive of obstruction, in which the symptoms are at first not urgent, and in which relief sometimes occurs without assistance, are—

1. Constipation, habitual or accidental.

2. Inflamed thickened intestine, the result of injury.

3. Chronic peritonitis (tubercular) and abscess.

4. Tumours pressing on the bowel—hydatids, &c.

5. Simple stricture of intestine, the result of ulceration and other causes.

6. Cancer of the bowel, producing contraction of the gut.

Although we have divided the usual causes of obstruction into two classes, each productive of its peculiar train of symptoms and effects, one of the acute character, the other of a chronic nature, yet it must be clearly understood, for it will certainly be found so in practice, that this division must only be taken as a mere outline map of the difficult country we have to explore; that in many cases the symptoms may subside from the acute into the chronic, or from a quiet state become very severe. It must not be taken as a fact in every case, that acute symptoms cannot or do not depend on any one of the latter causes of obstruction; or a more chronic state of symptoms on any of the conditions noted in the first division; but, as a general rule,

[1] Rokitansky's *Pathological Anatomy*, vol. ii. p. 59.

we may venture with some degree of assurance to assert, that the several symptoms which will mark the cases coming under our first division are urgent, acute, and rapidly result in collapse and death, if not relieved by nature or art; while the greater number comprised in the second division are attended by symptoms which come on by degrees, may last many days, often weeks, or even months in some cases; are generally by so much the less urgent than the former in character, and permit of delay in treatment as regards surgical interference, allow time for consultation, are often capable of medical relief, and, if surgical treatment be considered requisite, offer many more features favourable towards the prolongation of life, than do the acute cases of obstruction. It must be borne in mind that constipation, or entire stoppage of defæcation, is not an absolutely requisite symptom to indicate fatal obstruction of the intestine; nor, in suspected organic obstruction, should we presume to say that the disease has yielded to our treatment, even though a diarrhœal action occurs; it will probably last but for a short time, or the quantity of fluid passed will be small in proportion to the frequency of the motions. A relaxed state of the bowels in stricture is usually indicative of ulceration, and may occur, in old contracted stricture of the intestine, within a very short period of death.

Before entering upon the consideration of the individual causes of obstruction, it appears desirable (1) to attempt some kind of estimate of the periods of life at which different kinds of obstruction may occur; (2) to review generally the respective symptoms dependent on the various organic or accidental conditions; (3) to determine under what circumstances, and with what hope of success, operative interference may be had recourse to.

As regards our first proposition, it may be laid down, generally, that the causes of obstruction vary somewhat in youth, middle age, and old age. In youth they appear to be due chiefly to internal strangulation, caused by bands of lymph, adherent omentum, or diverticula, adhesions of various coils of bowel to each other, intussusception, foreign bodies taken by the mouth, cancer rarely, and that usually in the rectum. In middle life, from twists of large or small intestines, pressure caused by tumours, or pedicles of ovarian or other growths, gall-stones, intestinal concretions and foreign bodies, intussusception, simple or syphilitic stricture, mesenteric hernia, intestinal strangulation by bands, &c.; peritonitis, often resulting in abscess, simple constipation, and from cancer. In advanced life from cancer, thickened intestine, the result of an old hernia or other accidental cause, intussusception, simple or accidental stricture, and lastly from twist or internal strangulation.

The following table indicates to some extent the relative frequency of different causes of obstruction, irrespective of age. It is copied from Mr. Hinton's valuable communication on intestinal obstructions.[1] In 135 cases, the following were the causes of obstruction, in the order of their frequency :—

Diseased uterus			1
Stricture of ileum			1
Cancer of small intestine			2
Internal hernia:			
Inguinal, high up	1		
Diaphragmatic	2		
Meso-colic	2	8	
Obturator	3		
Fæcal accumulations			3
Twist of sigmoid flexure			4
			19

In first column	19
Concretions, calculi, foreign bodies	7
Doubtful	8
Peritoneal adhesions, tubercles, &c.	9
Stricture of sigmoid flexure	10
Ditto colon	11
Ditto rectum	11
Intussusception	24
By bands, adherent diverticula, uterine appendages, &c.	36
Total	135

1. Congenital malformations of the intestinal canal, giving rise to immediate obstruction, are almost entirely confined to the rectum and its external aperture. These deformities, and their treatment, will be found described in the essay on the Surgery of Childhood, and therefore require no further notice here.

Another, but very rare, condition of stricture has been occasionally found in the duodenum of infants: the two following cases illustrate these structural alterations :—

[1] *Ass. Med. Journ.* 1853, p. 431.

A child, when born, presented no unusual symptoms for the first twenty-four hours; vomiting then came on, and continued, with short intermissions, until death, which took place some thirty eight hours after birth. The bowels were never relieved during life. The only disease found was a stricture of the duodenum, close to the entrance of the gall-duct; so that a probe passed down the latter entered the duodenum immediately below the constriction. There was nothing to indicate from what cause the constriction had occurred. On the gastric side of the latter, the duodenum was immensely distended; so much so, that at first sight it appeared like the pyloric end of the stomach itself; and only by a more careful examination was the distinction between the stomach and intestine detected, by a ridge running around their place of junction.[1]

A child eighteen months old was admitted into the Hospital for Sick Children, under the care of Dr. West, apparently in much pain; constantly whining, restless, and throwing about her legs and arms. The mother had noticed that the child vomited frequently, rejecting everything she took; there was considerable constipation. The child died in a few days.

The stomach presented a constriction, beyond which was a pouch which looked at first like the stomach, but ended sharply at a spot where there was a fold of mucous membrane; beyond this followed intestine of ordinary character. A probe inserted into the bile-duct, from without, passed between the two surfaces of this septum, and appeared just below the stricture. The pouch was detected to be duodenum; and what appeared to be a fold of mucous membrane at the further end of the pouch, proved to be a septum stretched with a slight obliquity, across the calibre of the bowel. The septum was perforated almost exactly in the middle, by a small hole nearly circular, and with a smooth edge. The valve possessed all the ordinary characters of intestinal mucous membrane.[2]

These strictures, so similar in position and in anatomical relations, were probably the result of an abundantly developed valve of the duodenum; that in the second case becoming more obstructive as the infant grew, on the principle that orifices in membrane or soft tissues, the result of diseased action, generally acquire a tendency to contract towards their centres.

Such cases are interesting, but are quite beyond the reach of treatment.

2. Obstructions, the result of foreign bodies lodged in the intestines, have already been considered in the essay on Injuries of the Abdomen; we merely allude to them to complete the causes of obstruction in our table.

3. Twisting, 'dislocation,' or displacement of intestine, producing obstruction to the passage of its contents, is not a very common accident, but demands very careful examination when it occurs: for not only is its origin peculiar and its symptoms often obscure, but its treatment is a matter of very great consideration.

'Incarceration may be the consequence of a rotatory movement, and of this there are three varieties.

'*a*. A portion of intestine may have become twisted upon its own axis; and we then find that even semi-rotation causes such an approximation of its parietes, that they touch, and close up the passage. This can probably only occur in the colon; and according to cases on record, only in the colon ascendens. Accumulation of gas, and unequal filling of different portions of the intestine, appear, as far as we are able to judge from the few cases which have been noticed, to be the cause. Such an occurrence is scarcely conceivable in the small intestine, on account of the uniformity of its calibre, the absence of angular flexions, and its loose position, as every rotation of one portion upon its axis would be counterbalanced by the rotation of the next segment.

'*b*. The mesentery may be the axis, and the intestine will then be rolled up upon the former; *i.e.* the entire mesentery, or a portion of it, is twisted into a cone; and in proportion to the number of its rotations, more or less of the intestine will be dragged after it. In this case, we must take into consideration the traction and the pressure which the dependent mesenteric cone forms with the base whence its point rises. This variety can scarcely occur anywhere but in the small intestine and its mesentery.

'*c*. One portion of the intestine, either single or double—a coil—may afford the axis round which another portion with its mesentery is thrown, so as to be through-

[1] *Pathological Trans.* vol. xii. p. 101. From the plate which accompanies the description given by Dr. Wilks, it would appear that the contraction in all probability arose from a highly developed valve of the intestine; in the centre of this valve or stricture may be seen a very small circular hole, apparently not larger than would admit a probe.

[2] *Ibid.* vol. xii. p. 121.

out in contact with the circumference of the axis, and thus to compress it like a ferule. This variety is evidently a higher degree of the first, in which a portion of the intestine is merely compressed from before backwards, and, as it were, flattened down. A coil of small intestine, the sigmoid flexure, or the cæcum, may form the axis.

'The last two varieties occur, like the first, chiefly at an advanced period of life. In early life, a predisposition to the affection may be caused by a congenital malformation of the mesentery, by large herniæ, or by small herniæ when there is adhesion of the intestine.'[1]

It is a matter of some importance to be reminded of, that the seat of *most* incarcerations, *and of all twists*, will be found towards the posterior unyielding wall of the abdominal cavity; for it is only in that direction that pressure exerted on the intestine can effect its incarceration; the occurrence of a similar relation anteriorly is inconceivable, on account of the smoothness and yielding nature of the parts.

The symptoms of twisting of the intestine, especially of the sigmoid flexure (which is the most common variety), are very urgent from the first; great pain is suddenly experienced in a small circumscribed spot of the abdomen; obstinate constipation usually setting in from that date. If the sigmoid flexure is implicated, there soon follows very considerable distension of the abdomen, often distinctly observed to be chiefly confined to the left side. The distension of the abdomen is generally much greater when the large gut is affected than when the twist implicates the small intestine. In the latter conditions, fluids may be injected into the rectum very readily, and may remain, or return tinged by fæcal matter. In twists of the sigmoid flexure, we have injected fluids into this division of the bowel; if retained for a time, they do not return; the fluid has been thrown into the dilated sigmoid portion, and cannot again escape; vomiting is generally present, and often very copious and constant.

The following cases illustrate the history and pathological conditions of these accidents:—

A man, aged 28, having suffered for five days from irremediable constipation, died five hours after admission to the Hospital-ship *Dreadnought*. The sigmoid flexure occupied nearly the entire portion of the front of the abdominal cavity, and was in a gangrenous state. The bowel was immensely distended; obliteration of the muscular bands, and rupture of the serous coat, having taken place. This portion of the gut had been originally highly developed, and had now become strangulated, from falling over on itself towards the right side, causing a twisting and strangulation. The patient had, on previous occasions, been subject to constipation.[2]

A man, aged 65, was admitted into St. George's Hospital with a large circumscribed swelling, which occupied the greater part of the abdominal cavity, and apparently extended into the pelvis. Fluctuation could be distinguished over the whole of the tumour, the surface of which appeared smooth. No solid matter could be detected in any part of it. Percussion gave a clear sound in the upper part of the abdomen only, and there but to a small extent. *There was a tendency to diarrhœa.* A day or two after admission, peritonitis came on, with great pain in the abdomen and constant sickness. He died on the fifth day. The greater part of the peritoneal cavity was occupied by a large dark-coloured tumour, which had displaced the various viscera, and encroached upon the chest. This mass was formed of the sigmoid flexure enormously distended. The dilated bowel was connected to the left iliac fossa by a pedicle formed by an exuberant meso-colon, which was twisted upon itself, and had thus occasioned partial obstruction of the gut; the communications respectively leading into the colon above, and the rectum below, being small and tortuous. The sigmoid cavity was distended with fluid fæces, and contained one or two hard masses. The mucous membrane was of a dark livid colour, but not ulcerated. Extensive evidences of peritonitis were present.

A man, aged 55, was admitted into Charing Cross Hospital, nine days after almost complete obstruction of the bowels. A displacement of the bowel implicated the termination of the ileum, cæcum, and ascending colon. The latter was pressed upon and strangulated by the termination of the ileum and its stretched mesentery. Just at the part where the pressure was exerted, a gland in a calcareous state, as large and hard as a marble, lay immediately under the strangulated bowel, and had considerable influence in exaggerating the obstruction, as every effort to force the contents of the gut onwards tended to carry the gland into the opening. Close above the constriction the internal coats were extensively

[1] Rokitansky, *Pathological Anatomy*, vol. ii. p. 52.
[2] *Pathological Transactions*, vol. i. p. 103.

ulcerated, and perforation was about to take place. In this case an attempt was made during life to relieve the obstruction by operation in the left loin, but without success, as the obstruction was above the opening made in the bowel.[1]

A boy was seized with a violent pain in the stomach, and with sickness. These symptoms continued, varying in intensity, with complete constipation. He died on the ninth day. The intestines were matted together. The duodenum, jejunum, and ileum were greatly distended; the lower part of the small intestine was highly inflamed, and two loops of it were quite black from congestion. The mesentery of these loops had been twisted on itself, and had caused strangulation of the gut attached; and while in this state, the folds had fallen on an intestinal diverticulum proceeding from the small gut to the linea alba, about one inch below the umbilicus, and thus gave rise to an additional amount of mechanical obstruction to the circulation and contents of the bowel.[2]

These cases are apt illustrations of the usual forms of 'twist' of the bowel, such as occur, (1) in the sigmoid flexure; (2) about the cæcum; (3) of the small intestine. As a rule, such twists, when found in the small bowel, are usually nearer its lower than its upper extremity.

Rokitansky has very justly observed that the *predisposition* towards incarceration from twisting of the gut is dependent on a congenital, or acquired long, loose, flabby mesentery or meso-colon. But the mere existence of such a state, which allows of very free movements of the bowel, is hardly sufficient to account for the occurrence of a sudden strangulation of the parts. It appears to us that something is requisite to establish the twist; and that this something is to be found in an accumulation of fæculent matter, invariably present wherever such twists occur. This accumulation of fæces, fluid or solid, so loads and distends the bowel, that if accidentally it becomes shifted into a position unfavourable for the free passage of its contents, the intestine has no power to recover itself; nor has its peristaltic action any influence in altering its position, or that of the contained fæces. The mischief once started continues to increase by continued inlets of fæculent matter, without any corresponding outlet; for it will frequently be seen that, though fluid fæces from above can enter the sigmoid flexure when twisted, it rarely happens that much is able to escape into the rectum.

If, in the dead subject, the large intestine be distended artificially with water, and the mesentery of the sigmoid flexure be abundant, this portion of bowel is first seen to bulge forward, and then gradually rise up towards the diaphragm. In this movement there is a slight tendency observed towards a folding of the intestine on its mesentery; this when the abdomen is open, and no restriction applied to the bowel. We have not, however, been able, by simply distending the sigmoid flexure, to produce actual twist; perhaps our experiments were too restricted; and no doubt some other cause is wanting to induce it besides distension and free movement. Something, perhaps, depends on the motions of the body, more, perhaps, on the presence of the other viscera and the pressure or relaxation of the abdominal wall during life. The following particulars of a case bear strongly on this portion of our subject.

A man, aged 45, was attacked on the 10th of November with diarrhœa. This ceased on the 12th. On the 13th he was occasionally sick, and complained of deep pain in the region of the bladder; and this pain became paroxysmal and severe until his death. Along the whole of the left side an unusually hard and broad ridge could be felt, extending from the region of the stomach to the bladder. Death took place on the 15th, almost suddenly.

The peritonæum contained a considerable quantity of bloody serum. In the epigastric region was seen the transverse colon, with the omentum stretched and adherent to the abdominal parietes, on the left of the umbilicus. The left side of the abdominal cavity was entirely occupied by the sigmoid flexure of the colon; it lay obliquely, and had forced the diaphragm high into the chest. The meso-colon, which was greatly thickened and elongated, had become twisted on itself, and the intestine with it. The gut was enormously distended by fluid fæces, and was livid, from almost complete strangulation of its coats and vessels at the seat of twist. Mr. Gay, under whose care this case fell, found on examination that, in the state of tension, if the bowel was partly untwisted and then relaxed, it sprang back forcibly to its acquired and altered position; but that this tendency became less as the bowel was gradually emptied of its contents, until it required little manipulation to restore

[1] *Pathological Transactions*, vol. ii. p. 222. [2] *Ibid.* vol. vii. p. 205.

the bowel to its natural position, and this without any marked disposition to again become twisted. He very justly remarks, *that usually the tightness of the twist is in proportion to the distension of the bowel.*[1] A tube passed up the rectum after death in this case was with some little trouble introduced into the sigmoid flexure, beyond the obstruction, and could empty the bowel. When this was effected, and the body rolled over on the side, the twisted bowel righted itself.

The facts just quoted point to this rule in treatment, that relief in twist of the sigmoid flexure is just possible without opening the abdomen, provided the long tube can be introduced into the distended gut, its contents drawn off, and the twist reduced by the altered condition of the bowel. But no operation for the ultimate relief of the patient will be successful without the intestine be first unloaded, and the twist subsequently reduced. It may be stated as an axiom in these cases, that once formed, the twist prevents the escape of the contents, and the contents of the twisted portion maintain the distortion; to remedy the latter, the contents must be removed.

It will be observed that in one case already mentioned,[2] the serous covering of the intestine was found ruptured, after five days of constipation. This rupture had no doubt occurred previous to death. In an experiment made to distend the large intestine with water, the peritoneal coat in several places ruptured, before the muscular appeared inclined to give way under the pressure. This rupture of the peritonæum appears usually to commence over the transverse colon, and other portions are subsequently affected if the distension is continued.

This tendency of the peritonæum to rupture in rapid and great distension of the bowels, in cases of obstruction, indicates the importance of early interference, if any operation be considered desirable. When peritonitis has set in, in consequence of rupture of the serous membrane, or any other cause, operative interference would probably be too late to hold out any prospect of success.

4. Obstruction of the intestines occurs from a portion of bowel being strangulated in a loop, or bound down by a cord of false membrane; or it may be constricted by a diverticulum, adherent by its apex to some opposed surface of the viscera; or by the Fallopian tube, attached by its fimbriated process to some point of peritonæum; or by a thickened and elongated piece of omentum fastened down at the ends by adhesions; or by other accidental circumstances.

In an instance under the care of the author, a small ovarian cyst became suddenly dislodged from the pelvis, and from accidental circumstances, in its movement upwards it revolved so that its pedicle became twisted and consequently shortened. Symptoms of complete obstruction soon followed this displacement. When the abdomen was opened, it was found that the cyst lay just above the lower end of the ileum, and that the pedicle pressed so firmly upon the bowel that complete obstruction was thus effected.

All these conditions, favourable to the occurrence of internal strangulation, are generally the results of inflammation and effusion of lymph.

5. Peritoneal pouches, which have usually well-defined rings for their orifices, and the foramen of Winslow—but this rarely—have been the seat of obstruction and strangulation of the bowel.

The causes of obstruction mentioned in these latter instances are attended by symptoms entirely similar, and only require to be separated as regards their pathological conditions, but in treatment may be considered under one head. However, those obstructions which are due to the products of inflammatory action may occur at any time of life, but most frequently in the young, are very uncommon in old age, and are often found in children; whereas strangulation by a mesenteric pouch is usually observed in somewhat more advanced life.

Females are rather more liable to internal strangulation than males; for the appendages of the generative organs offer additional points for adhesive inflammation, and, consequently, entail so much more danger. In most, if not in all, of the conditions now under consideration, the small intestine is usually alone implicated.

The history and pathology of internal strangulation caused by false membranes and adhesions producing loop, &c., are best illustrated by the following cases:—

[1] *Pathological Transactions*, vol. x. p. 153.

[2] See the first case on p. 713.

A preparation in the Museum of St. George's Hospital shows the formation of a short band of lymph, adherent by one extremity to the free surface of a portion of small intestine; from this the band is seen to pass over another portion of small intestine, and then is immediately attached by the other extremity to the mesentery supporting the latter piece of bowel. As the effused band of lymph contracted, it so pressed on the portion of intestine which was crossed by the band, that entire stoppage of the bowels was produced.

A young lady, aged 19, died after a few days' symptoms of strangulation and vomiting. The omentum was firmly adherent to the anterior abdominal wall. This was the result of old adhesions. The small intestines were greatly distended. At the lower part of the abdomen, on the right side, and dipping into the pelvis, a large portion of sphacelated intestine was seen. This was about five inches in length, and consisted of the ileum, which was constricted and strangulated by a ring formed by lymph which had been effused in some former attack of inflammation. The ring was so firm that it was obliged to be cut through to liberate the intestine. It was formed by the band of lymph being attached by one extremity to the inner surface of the caput coli and stretched across to the ileum, to which it adhered by the other.

A child 4 years of age died after five days' constipation and symptoms of internal strangulation. The cavity of the abdomen contained some serum deeply tinged with blood. At the lower part of the belly several convolutions of small intestine were highly congested and dark-coloured; this to the extent of a foot in length; and one portion of it was almost black in colour. This latter portion was found strangulated by a band of false membrane, which was attached by one extremity to the point of an appendix, by the other to the mesentery. The appendix was attached to the lower portion of the ileum, and was about an inch in length, and communicated with the bowel. The appendix, and the band with its attachments, formed a complete ring about an inch in diameter.

A man, aged 20, died after fourteen days' complete constipation. Near the termination of the ileum, a portion of it, nearly two feet long, much distended and much darker than the rest, was firmly constricted by a narrow band (not thicker than whipcord), which passed from the vermiform process to the ileum close to its mesenteric attachment.[1]

In a case in which a portion of small intestine was strangulated through a loop in the great omentum, perforation of the bowel had taken place, and had allowed the escape of fæces.[2]

A man, aged 68, was admitted into St. George's Hospital on March 7, 1861. He had been lifting some heavy iron about eight days previously, when he felt a sudden strain, and immediate severe pain in the loins and belly. He passed a restless night; the next morning there was slight action of the bowels. He complained of pain chiefly in the belly and dragging at the umbilicus; there was also constipation from the second day of pain. Four days after the attack he first vomited; but now everything taken was rejected. The skin was cold, and eye sunken; there was blueness of surface, and the pulse was small and weak; the tongue dry and brown; abdomen enormously distended and tympanitic. No stricture could be detected through the rectum. An enema-tube would not pass readily beyond a short distance. Mr. Johnson decided to open the descending colon, with a hope to relieve the distension; but the bowel, when cut down upon, was found collapsed. The question of making an exploratory opening in the abdomen from the front was considered, but decided against. The patient died on the eleventh day. The small intestine was very vascular. At the lower part of the ileum, close to the ileo-cæcal valve, a band crossed the small intestine, forming a ring around the gut and the commencement of the mesentery. The origin of the ring was observed to spring from the sigmoid flexure, which was drawn over to the right iliac region so as nearly to touch the cæcum. The tissue forming the ring was loaded with fat, closely resembling the structure of an epiploic appendix. The other appendices were very long and broad, and some were perforated at their base, and presented an incipient condition of such a ring as had embraced the intestine. There could be little doubt that this ring was either formed in an appendix, or was formed by the adhesion of two neighbouring appendices. The gut, where it was bound down, was deeply marked by the stricture. From the stomach to the situation of the obstruction the bowel was greatly distended, but more particularly at the lower part, where for about a foot in length it was stretched so tight that it burst under a stream of water thrown in to wash it out; and was nearly black from congestion. The constricting band was not adherent to the intestine, and after removal from the body the gut could be easily moved backwards and forwards in the ring. The position of the obstruction was immediately over the right common iliac artery. The cæcum and upper part of the large intestine were of the natural size, and contained fæces; the transverse and lower portions were empty and contracted.[3] The external wound was just below the left kidney.

Strangulation of bowel through the foramen of Winslow is most rare. We cannot point to any case within our own experience.

Obstruction caused by bowel becoming entangled or caught in a mesenteric or meso-colic pouch is not so unfrequent.

[1] *Path. Soc. Trans.* vol. ii. p. 62. [2] *Ibid.* vol. i. p. 259.
[3] *Ibid.* vol. xii. p. 111.

A specimen of meso-colic hernia, which had not been attended by strangulation of the bowel, was exhibited at the Pathological Society, by Dr. Peacock, in 1849; having been removed from the body of a man aged 30. The left half of the transverse colon was deflected in a longitudinal direction, down the middle line, to the brim of the pelvis, and pushed forward by a large swelling, which projected on each side of the displaced colon. None of the small intestines were to be seen; but were found concealed in the swelling. This proved to be a large pouch formed by a fold of the meso-colon. It was opaque below, but the convolutions could be detected through it at the upper portion. The jejunum entered the pouch at the upper and posterior part; and the ileum passed out below and on the right side, about two inches above the termination of this portion of the intestine. There was no evidence of constriction of the bowel; nor did the displacement appear to have been productive of any inconvenience or disorder.

A second similar case was attended by strangulation of the intestine, and death. A man, aged 27, was seized with pain in the abdomen, and vomiting. He vomited everything taken, and the pain in the stomach was most severe. He died about forty-one hours after the commencement of the attack. The descending colon was found lying on the left side of the cæcum, and the small intestines were contained in a large pouch formed in the left meso-colon, and situated on the left side of the corresponding large gut. The ileum passed out of the pouch about two inches above the cæcum, and at that point the bowel was contracted, thickened, and gangrenous.[1]

We have next to consider the symptoms and diagnosis of such causes of obstruction as have been already referred to. The symptoms in all such cases are, as a rule, very acute in their character; and prove rapidly fatal if not early relieved. A twist of the *large* intestine, in its first onset, may to some slight extent be an exception to this rule; but even in such an instance the more acute symptoms will surely appear at a comparatively early stage unless the obstruction be removed.

But, to whatever cause obstruction may be due, the symptoms are commonly so similar, that a correct diagnosis as to the exact seat or actual cause of the block is not often to be expected. We may, by careful inquiry and examination, approach somewhat near it. But, whether occasioned by intestine entangled in a loop, or fissured omentum; by a cicatrix or simple stricture; by a foreign body, or by a twist contracting a portion of gut; the symptoms will not vary much in character, though they may somewhat in degree, as well as in the periods of their commencement and sequence. Tension of abdomen, pain, absence of all abdominal movements, constipation and distension, with the coils of intestine often defined on the thin abdominal wall, and persistent vomiting: each and all may be present, and should be present to constitute the conditions of absolute obstruction. Vomiting, however, must always be looked upon as the most important indication of the completeness of the block. Its early commencement and its persistence indicate more than any other single symptom the urgency of the case, and the vital necessity of some immediate interference if life is to be saved by any available surgical means. In all internal strangulations, it must ever be borne in mind that the symptoms are always acute; pain is sudden, sharp, and occasionally agonising; vomiting sets in early and is usually incessant. At first the contents of the stomach alone are rejected, but if not soon relieved, fluid with fæcal odour and in large quantity will now be brought up. The distension may not be so great, as often occurs in the more slowly operating causes of obstruction; but still the small intestine, above the seat of block, will become much loaded; there is generally great tenderness on pressure, for peritonitis is not long delayed; the abdominal muscles feel rigid to the touch, there is early evidence of grave constitutional damage, anxious and drawn countenance, especially in children, for the portion of intestine at the strictured part may soon thicken and inflame, or rapidly congest and mortify. The increasing distension of the upper bowel which occurs as long as the block lasts adds materially to these evils.

In the first instance in the early period of suspicion of obstruction, purgatives should be scrupulously avoided. This precaution cannot be too rigidly attended to at the commencement of symptoms. If there be a golden rule to guide us in the treatment of cases of obstruction it is this—that opium be administered by the mouth, and aperients by the rectum alone. Every rule may have an exception, but experience has taught us, that whenever this rule has been departed from occasion for regret

[1] *Path. Soc. Trans.* vol. ii. p. 60.

has followed. In addition to the internal use of opium, enemata should be used early and freely. Their administration will soon prove whether the lower bowel is free and capable of retaining a proper quantity of fluid, or whether, when this is returned, there comes with it any fæcal matter indicative of some escape from above.

In twists of the large bowel, should an injection be used and not be returned, its repetition will but add to the evil; for fluid can sometimes be injected into the twisted portion, and yet is not capable of being returned. After the lower bowel has been thoroughly washed out, and the subsequent enemata return in much the same condition as they were injected, it will clearly indicate that no further passage of fæces is likely to be effected by their continued use. The persistence of vomiting should then decide the question that no further relief can be obtained without an exploratory operation. Given the distension, arrest of all fæcal discharge, and persistent vomiting, no other conclusion can be arrived at but that absolute obstruction exists. Under such circumstances, if life is to be saved, there is no alternative, after all other measures have been tried and failed, but to seek the seat and cause of the evil through an abdominal opening, and endeavour to relieve it. Delay is now dangerous, and the earlier the operation is performed the greater the chance of recovery for the patient.

To decide on this operation sufficiently early is the important responsibility thrust somewhat suddenly on the medical attendant. It too often occurs that the operation is too long delayed to render it successful. Its performance is of so serious a character, and the nature of the obstruction usually gives so little time for consideration, while a chance of successful relief from operation lasts, that we cannot impress on the practitioner too strongly the importance of early action under the circumstances mentioned. It must never be lost sight of that incessant vomiting is essentially the most important symptom, as indicative of a block which necessitates an operation for its relief. If allowed to continue, it is in itself a source of extreme exhaustion: if allowed to continue until it becomes fæcal in character, still less hope can be entertained from the effects of an operation. Fæcal vomiting not only indicates the serious character of the block, but also that that block has existed, comparatively, some time. It may have been long enough to permit the commencement of gangrene, or to have set up peritonitis sufficient to banish the small hope we might otherwise entertain that an operation held out some prospect of life. Delay in operating accumulates danger after a patient has been known to vomit a few times. Peritonitis established without even a gangrenous condition of bowel is a formidable antagonist after an operation, even with perfect liberation of the stricture.

In the treatment of external strangulative hernia, when reduction cannot be otherwise effected, we have made it a rule invariably to operate as soon as vomiting had set in. Our maxim has been, *never to allow a patient to vomit three times*, but to operate as soon as vomiting commences, if called in sufficiently early to carry out this treatment.

In all these cases—acute obstruction, from whatever cause—the operation, being decided on, should be conducted in the usual method of opening the abdomen, by an incision commencing in the median line just below the umbilicus, and carried down two or three inches towards the pubes. Should this opening not prove sufficient to enable the operator to ascertain the seat or cause of obstruction, it may be enlarged upwards or downwards, as most convenient under the circumstances. The protrusion of distended bowel will often prove a difficulty in this stage of the proceeding, but the intestine may generally be held aside by an assistant sufficiently to enable the operator to explore the abdomen with finger or hand.

It will often be found difficult to detect the seat of the block without following the course of the intestine; the operator will generally find that this is more readily effected by commencing from below, and tracing up the contracted and empty gut, than to endeavour to follow down from above the distended portion, till the seat of stricture is reached.

It is almost impossible within our limits to lay down absolute directions as to the measures to be adopted in the various conditions which may be met with under

many circumstances; much must be left to the discretion of the operator to overcome whatever difficulties he has to encounter. If one portion of small intestine is distended and another contracted, the probability is (intussusception excluded) that the cause of obstruction will prove to be some form of internal hernia, or a band constricting, rather than any stricture of bowel. In the former case it is usually not difficult to reduce the strangulated portion by gently pulling on the collapsed portion, and we have succeeded in doing this without the slightest trouble, after internal strangulation, dependent on a loop of the small intestine entangled in a pouch in the mesentery. In this instance it was most interesting to observe, as soon as the obstruction was relieved, the collapsed bowel commence gradually to become inflated from the passage of air into it from the bowel above.

If the obstructing cause be due to a band, this should be divided at whatever may be considered the most desirable point; and should there be any evidence of bleeding from the cut surfaces, it is best at once to twist the vessels, or apply fine catgut ligatures to the bleeding points, or even prior to the division of a band, if large or broad, ligatures may be applied in either side of the proposed line of division. The removal of a tumour will of course be requisite if the cause of obstruction, as occurred in the practice of the author. In this instance the pedicle of an ovarian cyst lay over and compressed the ileum. In twists of the bowel it is not generally difficult to detect the evil after the abdomen is opened. Some care is requisite in handling the distended intestine. Its distension produces a softened condition of its coats, and under such circumstances the bowel is very apt to be torn or to rupture, unless very carefully manipulated. Twists of intestines must always be considered as most severe and grave conditions to deal with, and do not offer much hope of benefit from operation; still the effort should be made, as we are quite unable by any other means to relieve the obstruction. In the case of a foreign body being impacted in the bowel, there is no alternative but to remove it. If practicable, the portion of bowel in which the obstructing mass is lodged should be carefully drawn out of the abdomen; the intestine may then be opened, the substance removed, and then the orifice in the bowel closed by a continuous suture of fine silk or catgut. This subject will be found fully discussed under the head of Injuries of the Abdomen.

The obstruction being removed, the margins of the abdominal wound are to be brought together in the usual manner, by sutures passed through its edges so as to include the peritoneal surfaces, and the surface dressed with dry absorbent cotton, and flannel bandages lightly placed round the body. The patient should be kept fully under the influence of opium for some days, the water drawn off if necessary every four hours, and the bowel not interfered with for a week, and then only by enemata. Very small quantities of fluid food, with ice to allay thirst if requisite, should only be permitted for the first six or eight days.

Such are the general rules applicable to acute cases of obstruction, and which will be found with few exceptions to be confined to the small intestine.

We have next to consider another cause of acute obstruction, which may implicate small and large intestine. We refer to—

6. Invagination, or intussusception of the bowel, is often the result of irritation caused by worms; of tumours attached to the mucous membrane; and of other accidental causes, not always to be detected or explained.

Invagination may frequently be observed in the post-mortem examinations of children. It also often takes place in grown-up persons of all ages and of both sexes, and in almost every portion of the intestinal canal.

Invagination may occur in one or in several parts of the bowel at the same time in the same individual; but when, on examination after death, several intussusceptions are met with, they are usually slight, and have not been productive of urgent symptoms during life.

In illustration of some of the causes of intussusception, the following examples are worthy of record :—

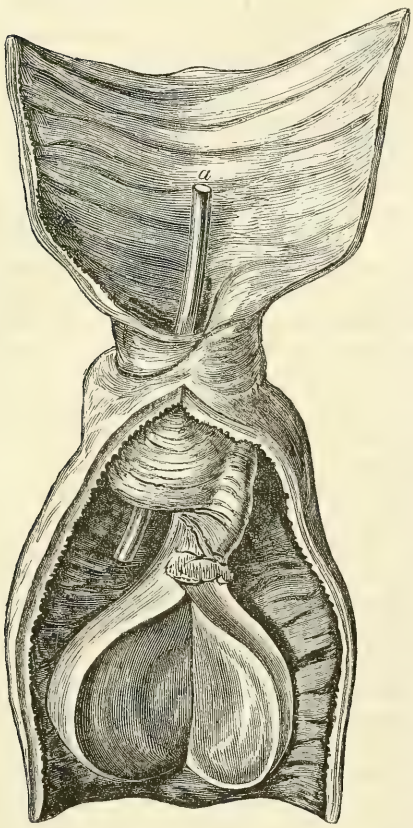
In the Museum of St. George's Hospital is a preparation, which shows an intussusception caused by the presence of a tumour growing from the wall of the bowel and projecting into

its cavity. A process of sloughing has nearly detached the prolapsed portion from the rest of the intestine, and so almost set free the tumour. The patient died of peritonitis.

Another preparation in the same Museum displays a portion of small intestine invaginated, apparently from the irritation set up by an ascaris lumbricoides, which may be seen coiled round the prolapsed portion. But many other parts of the bowel were also invaginated ; and when the patient died, the state of the bowel was not suspected.

The anatomy of intussusception is interesting. The usual form of intussusception met with is an inversion of a portion of intestine into the tube of the gut immediately below. But the relative conditions of the upper and lower portions of the bowel may be reversed ; the intestine below may be projected into the intestine above, and this would still constitute an intussusception. This latter state, however, is exceptional ; the former is not uncommon, and may prove fatal if not relieved.

Fig. 158.—Intussusception, caused by the Traction of a Fibrous Tumour of the Intestine.



A perpendicular section through an invagination will display on each side, and lying parallel with each other, three layers of intestinal wall ; a transverse section would show these rings of intestine, one within the other. In each section, whether perpendicular or transverse, the opposed surfaces of the intestine will correspond in character ; peritonæum will touch peritonæum, and mucous membrane be in contact with a similar tissue. The outer surface of the external layer is peritonæum ; the lining of the inner layer is mucous membrane ; but between these there are two opposed surfaces of mucous membrane, and two likewise of peritonæum. Between the inner and middle layers, and in the space lined by peritonæum, will be a certain portion of mesentery or meso-colon dragged in by the inner layer of bowel as it becomes prolapsed. The limit of the invagination above is at the outer or peritoneal surface of the bowel, and consists of an obtuse edge, formed by the folding in of the intestine at that point. The lower limit is inside the tube, and can only be observed when the gut is laid open. The portion of intestine which receives the invagination is a single layer ; the invaginated portion, that which slips into the former, consists of two layers of bowel. A portion of mesentery will be found between these two layers, its size and shape varying with the length of the prolapsed intestine. The lowest extremity of this impacted mesentery is almost drawn to a point, and is near the extreme lower part of the prolapse. The mesentery is thicker and broader where it enters the fold between the two layers of intestine, so that it becomes somewhat triangular in shape as it lies between the two layers of intestine already alluded to. As the mesentery is attached to one margin of the bowel, the bowel in prolapsing is somewhat retarded by the mechanical action of the former ; for the mesentery, being always in a state of tension, drags upon one side of the prolapsed bowel ; it will therefore be found, especially in an extensive prolapse, that the prolapsed end of the gut, its inner extremity, is turned in the direction of the attached mesentery ; from which circumstance the piece of bowel presenting the prolapse will be found slightly curved to one side, and thus the whole mass assumes a crescentic figure.

Rokitansky, in referring to this condition, makes the following important remarks :—

‘ Firstly, that the invaginated portion does not lie parallel with its sheath, but always

offers a greater curvature than the latter, the inverted tube being compressed on its concavity into tense transverse folds. Secondly, that the orifice of the invaginated portion of bowel does not lie in the axis, or in the centre of the sheath, but towards the side; and that, following the traction exerted upon it by the mesenteric fold that belongs to the inverted intestine, it is directed towards the mesenteric wall of the sheath; that the opening is not circular, but represents a fissure. This affords a diagnostic sign for the examination of intussusceptions of the rectum, which are within the reach of manual exploration.'[1]

Though intussusception may occur in almost any part of the intestinal canal, it is most frequently found towards the middle and lower portions of the small intestine, and may implicate any portion of the large bowel. When an intussusception increases in size, the involution is usually that of the bowel below the commencement of invagination; if this commences at the lower part of the ileum, more of the upper ileum does not disappear, but the prolapse grows in length at the expense of the inferior portion of the intestine. It will frequently be found to extend to the rectum, whether commencing high up or in the descending colon, and may even protrude through the sphincter. Should it originate in the lower part of the ileum, it may continue downwards so as to involve the ileo-cæcal valve, cæcum and colon more or less.

A boy, nearly five years of age, complained of soreness about the anus, the result of ascarides. The next day he was seized with sudden pain in the lower part of the abdomen, and strained several times at stool, but passed nothing. He soon afterwards vomited. He continued to go to stool every half-hour. In the afternoon he experienced constant desire to go to stool, and passed a clot of blood. On some of these occasions he passed dark-coloured blood and slimy matter. There was great restlessness, and thirst. The abdomen was more swollen above than below the umbilicus. There was much tenderness over it on pressure. The symptoms continued unrelieved, and death took place on the fifth day. A considerable intussusception had occurred of the ileum through the ileo-cæcal valve; the appendix was also carried in. About $3\frac{1}{2}$ inches of bowel protruded into the cæcum. The involved part was of a deep red colour. It was so firmly grasped by the ileo-cæcal valve, that the effort to reduce it appeared likely to tear the bowel.[2]

A child, six months old, died after sixty hours of suffering from vomiting and discharge of bloody mucus from the rectum. The whole of the colon, ascending transverse and descending, had passed into the sigmoid flexure. The mucous membrane of the prolapse was purple from strangulation.[3]

The two foregoing cases mark the prominent symptoms of acute invagination of intestine; sudden pain; constant and urgent desire to stool, with little fæcal matter passed, but blood in clots or bloody mucus escaping in small quantities; more or less vomiting; great distress, both general and local; and death following in a few days. But death may be somewhat sudden.

A sailor, during a railway journey, was observed to place himself on the floor of the carriage. but had no attention paid him by his fellow-passengers. At the journey's end he was found dead. The abdomen presented marks of severe peritonitis. A fold of intestine near the termination of the ileum, six inches in length, was intussuscepted and gangrenous. Probably in this instance the mischief was of some few days' duration.[4]

It will thus be seen that intussusception may be confined to a comparatively small portion of the small intestine, while at the same time the obstruction may be as complete as it is sudden; or it may implicate both small and large bowel, and yet the symptoms may not be urgent till some days, or even some weeks, have elapsed, and ultimately prove fatal.

In the first instance the case may be distinguished as *acute*; the symptoms will be severe soon after the attack, and indicative of complete obstruction and strangulation, to be rapidly followed by the death of the part; which may be thrown off and be passed by stool, and the patient recover, or may be followed by perforation of the bowel and the death of the patient. In the other case, though some of the symptoms of invagination may be present, there need be no absolute obstruction for weeks following the commencement of the invagination.

In other instances the symptoms appear to extend over a much longer period,

[1] *Path. Anat.* vol. ii. p. 55.
[2] *Path. Trans.* vol. ii. p. 55.
[3] *Ibid.* vol. ii. p. 56.
[4] *Ibid.* vol. i. p. 77.

and ultimately prove fatal; or if the strangulated bowel slough off, may terminate favourably.

A man, aged 25, suffered from attacks of colliky pain in the abdomen, and gradually lost flesh. One day he became suddenly worse, and on the following day died; nearly four months from the supposed date of the commencement of his attack. About six inches of ileum, cæcum, and the first part of the ascending colon, had passed into the large bowel beyond. There was no appearance of gangrene in any part. The colon contained much mucus and coagulated blood. The mucous membrane was turgid and purple. The involved layers of the intestine were firmly adherent to each other by dense bands of false membrane.[1]

The separation and passage of the strangulated portion, with recovery, is a result we may occasionally anticipate, and it has been known to occur in some few cases; nor does the loss of the piece of bowel appear to be attended by any subsequent evil consequences.

A boy, aged 5, was taken ill four months previously to the time at which a mass of bowel was passed. At first he suffered from simple fever, but afterwards experienced much distress. He complained chiefly of pain in the region of the bladder; but there was no tenderness. The urine was sometimes retained for a long time. The bowels were very much confined, sometimes for fifty hours. There was occasional vomiting. He was never known to pass blood. *Eight inches of the ileum, the cæcum with its appendix*, and about four inches of the colon, were passed by stool. The tissues were almost black, and offensive. Diarrhœa preceded the discharge of the separated bowel. At the end of six weeks from this event the little patient seemed quite well, and the bowels acted regularly.

This case occurred in 1847, under the care of Mr. Hesilridge Buckby, of Sutton-on-Trent. In September 1863, he kindly wrote to the author to the following effect: 'I have much pleasure in informing you my little patient has continued *in perfect health* ever since his restoration. I saw him the other day.'

V. T., aged 18, was seized with severe paroxysmal pain in the abdomen. This continued and increased without relief; and was followed by stercoraceous vomiting. Symptoms of general peritonitis came on, without any relief from the bowels. The more urgent symptoms were relieved under the use of calomel and opium; but no evacuation was obtained. On the tenth and following day enemata were returned without any fæcal tinge. On the twelfth day some fæculent matter was brought away; and more fæces passed after a dose of castor-oil. On the nineteenth day he had three motions. The last consisted of bright florid blood, mingled with many portions of the small intestine. The two previous motions were said to have been of precisely the same character, and to have contained many 'skins.' At the expiration of six weeks the patient returned to his usual occupation.[2]

Peritonitis may be the result of perforation of the bowel during the separation of the sloughing prolapse, in which case acute pain and much suffering are generally followed by rapid death.

It will appear that, although invagination has been classed with the causes of acute strangulation, many cases occur in which the symptoms are not very acute, last some time, and even terminate in recovery, though at a sacrifice of a portion of the bowel.

The general symptoms of intussusception are usually—pain referred to the seat of the mischief, often of an acute character, sudden in its attack and confined in its extent; constant and often urgent desire to evacuate, but without satisfactory result; scanty motions more or less mixed with mucus and frequently with blood; generally a swelling, sausage-like in shape, is to be felt in or near the position of the ileo-cæcal valve; constipation according to the amount of obstruction; and vomiting when obstruction becomes entire; then also will distension of the bowel follow, and gradually become more and more evident. In the more chronic case distension may not occur, and will most probably be but slight, if at all present. No age is exempt from invagination, but children are most liable to its occurrence. In a table, drawn up Mr. Hutchinson, of 131 cases, 90 occurred in children of six years of age and under.[3]

The pain in such instances is often intermittent, but well marked; when present, the child doubles itself forwards and often rests its head on the bed, kneeling. Intussusception without strangulation may not even be suspected for some time after its commencement; in some cases not until the end of the invaginated bowel is

[1] *Path. Trans.* vol. vii. p. 193. [2] *Ibid.* vol. vii. p. 199.
[3] *Med.-Chir. Trans.* vol. lvii.

detected in the rectum, or has made its appearance through the sphincter. But in all acute cases there will be early passage of blood, distension of the abdomen from the bowel above the block becoming dilated by fluid and flatus; constant desire to defæcate without the trace of any fæculent matter in whatever is passed; continuous vomiting of all fluids taken by the mouth, and that ejected becoming fæcal in odour if the patient survives many hours. The obstruction being fully established, nothing but blood or bloody mucus will be passed per anum.

In the more chronic form, as the invagination increases (which is always the case) and is allowed to remain unrelieved, without any general symptoms of obstruction, a change will probably gradually occur which will render it incapable of being reduced. This change is usually rapid in the acute form, but may not occur for some weeks in a chronic case. From pressure exerted on the coats of the bowel and its mesentery, congestion followed by inflammation is sooner or later liable to occur. One result of this is a more than natural secretion from the mucous surface of the entangled piece; frequently the discharge is mixed with blood; a symptom of much importance in the diagnosis of intussusception, for we may safely say the greater the proportion of blood the more complete the obstruction. But as the invaginated mass becomes thickened the peritoneal surfaces become gradually adherent to each other, commencing at or near the entrance of the upper ring of the sheath. At this line there will also be a certain amount of strangulation exerted upon the portion within the ring. This is the first step made by nature to remedy the evil, if it be not otherwise relieved, so that presently the prolapsed portion may be cast off by slough, and also that the escape of the contents of the bowel may be provided against, by the cohesion and subsequent union of the upper and lower portions of what would otherwise be a severed intestine.

From what has been already said, it will be apparent that it is a very important point in practice to be able to diagnose between the more acute cases in which strangulation early ensues, and the more chronic forms of invagination, in which much bowel may be implicated and yet give time for hopeful interference. Whatever portion of bowel be involved, and to whatever extent it may be implicated, the first thing to be done in the investigation of a case, given the general symptoms, is to examine the bowel per rectum; frequently the lower end of the involuted part will be there detected by the finger. This will at once be diagnostic of intussusception, although it may not indicate the extent of bowel involved. If no evidence of prolapse be found in the rectum, it is next desirable to examine carefully the surface of the abdomen in order to detect any swelling caused by the invaginated mass. This often is not difficult to discover, but, should the resistance of the abdominal muscles or the distended state of the bowels obscure its position, the use of an anæsthetic will prove advantageous by relaxing abdominal rigidity, and generally will enable the surgeon to detect the seat of obstruction by the presence of some swelling or hardness. The prolapsus having been detected in the rectum, or suspected elsewhere from the existence of a tumour and general symptoms of invagination, enemata of warm water or injection of air may be tried with a hope to overcome it. The pelvis of the patient should be well raised during this time, the better to retain the fluid, and thus by its weight to assist in the attempt at reduction. If the prolapse be suspected to be confined to a portion of the lower bowel alone, the introduction of a bougie may possibly reduce it; but the experience of the author entirely confirms the following observation of Mr. Hutchinson's, 'I have not found any case recorded in which spontaneous return of a well-recognised intussusception occurred; and those in which art succeeded are comparatively rare.'[1] But as a rule when extensive invagination has taken place no amount of injection or use of bougie will prove useful, beyond the fact that the return of the injected water, if unmixed with fæculent matter, is a pretty clear index that complete obstruction exists; or, if mixed with even a small amount of fæces, the condition is such as to leave more hope of relief by operation. The mechanical condition of a large portion of invaginated bowel renders it perfectly

[1] *Med.-Chir. Trans.* vol. lvii.

hopeless to expect any benefit from any treatment short of operation, supposing, of course, that the invagination has not already been relieved by slough.

In the last edition of this work the author supported the view that it were better to allow a case of intussusception to run its course, with the prospect of its being relieved by slough, rather than to interfere by abdominal section with the hope to relieve it. Since then several cases have been operated on with varying success by several surgeons, and also by the author. The result of this conjoined experience is, that in many cases the operation is to be advocated, should certainly be undertaken, and may probably prove successful.

But, as Mr. Hutchinson has pointed out, some discrimination is needed in the selection of cases for operative interference. He has properly classed cases of intussusception as those which are early marked by symptoms of *strangulation*, and those which are simply *irreducible*, except by surgical interference. 'The former tend rapidly either to the death of the patient, or his relief by gangrene of the constricted part.'

It is only in the more chronic cases that operative interference is likely to prove beneficial. In the more acute cases in which complete strangulation has occurred, made evident by entire stoppage of fæcal matter, passage of blood only, and continued vomiting, unless an operation be performed for its relief very early indeed after intussusception has occurred and is detected, it will probably prove a failure, for when the bowel is attempted to be unravelled, the parts, from having become matted together, render reduction impossible. Such was the case in an instance under the author's immediate observation, although the operation was performed within forty-eight hours of the commencement of the stoppage. In this case it was found impossible to reduce the invagination either from below or from above, without the application of force which would have torn open the bowel; the mesentery became slightly lacerated in the attempts made at reduction. The child nearly died on the table, before the wound of the abdomen was closed, and only survived the operation a few hours. Mr. Hutchinson remarks that, 'if the operation were resorted to in cases of acute strangulation, there would always be a risk that the surgeon might find the parts in a state of gangrene, and might discover that he had interfered only to take away the patient's last chance.'

In the more chronic cases, however, the operation should be at once attempted when other measures for the reduction of the bowel have not proved successful, for we know from experience that there is no possible chance of reduction of the prolapse if left to nature, and that the longer it is left unrelieved the greater the chances of adhesion, exhaustion, or even gangrene.

The operation of opening the abdomen for the relief of intussusception is in all respects similar to that for any other form of obstruction, and has been already described. But with regard to the prolapse itself, it is necessary to say that some difficulty may be encountered in the attempt to reduce it. As in the management of obstruction from other causes, so in intussusception, we have found it most convenient and more easy to follow up the empty portion of bowel from below the seat of obstruction, and to draw upon it when arrived at that point, rather than endeavour to effect the reduction by manipulating and drawing upon the upper and distended bowel.

It must ever be borne in mind that to open the abdomen in any case of obstruction is a very serious undertaking; in almost all its aspects more serious than abdominal section for the removal of a tumour. Prior to operation in the latter case the intestine can always, and always should, be emptied; in many instances during the operation the intestines are hardly seen, and but little exposed; we remove what is often a source of much local trouble. In the former the intestine above the obstruction is always somewhat distended, often greatly distended. The patient, too, is already more or less exhausted by vomiting, if not by some greater and graver evil dependent on the prolapse. Without such complications, the simple abdominal section in one of tender years

[1] *Med.-Chir. Trans.* vol. lvii.

—it may be even in one of infancy—is of itself a very serious risk, when it is recollected that the bowel must be exposed to a great extent. Under such conditions a serious depressing influence is produced by this exposure. The protruding and distended intestine may also become a source of trouble, even after the invagination has been reduced, for difficulty is occasionally experienced in replacing the bowels within the peritoneal cavity. This may greatly prolong the operation and add to the exhaustion of the child. Even when much distended, we would prefer not to puncture the intestine, if it be possible to avoid doing so. After such a puncture a patient has been known to recover, but on the other hand the puncture has been known to prove fatal, by allowing the contents of the bowel to escape into the peritoneal cavity. If it should appear impossible to replace the bowel without in some way or other diminishing its calibre, the most prudent step is to puncture it with a fine trocar, and, previous to the intestine being returned, to secure the punctured point with a ligature, so that the best possible precaution be taken to avoid the escape of its contents.

We have now to consider the more chronic conditions productive of obstruction.

1. Habitual constipation may become accidentally prolonged to such an extent as to cause anxiety; or the accumulation of fæcal matter may be mistaken for a tumour, so circumscribed occasionally is the collection in the large intestine. The time which may elapse while the bowels are entirely closed, and the amount of fæces which may be collected therein, would surpass belief, were it not that the experience of those now living can confirm the statements made by writers on this subject.

A lad, aged 7, on recovering from an attack of fever, was affected with great torpor of the bowels. This gradually increased to such an extent that in two years treatment failed to have any effect. When admitted into the Free Hospital, under the care of Mr. Gay, it was stated that *nothing whatever had passed from the bowels for three months.* The health had not suffered; the appetite was good. The body was greatly enlarged, and was forty-nine inches in girth; and there was inconvenience to respiration. There was considerable prominence on the left side, as if the colon and sigmoid flexure were chiefly loaded.

A speculum was passed into the rectum, and, after dilating it, an enema tube was passed high up. The contents of the bowel were washed out by a stream of warm water kept constantly playing upon them, for half an hour at a time. A large quantity of hard black fæces, like cinders, was brought away. These measures repeated several times reduced the girth of the abdomen to twenty-six inches.[1]

The surgeon is usually consulted at the latter period of obstinate constipation, which has at last arrived at complete obstruction of the intestine; and as all power of propulsion is then lost, the contents have to be removed mechanically. This can only be done by the aid of repeated warm-water enemata; or by means of some kind of scoop or short lever, with which the lowest masses of hardened fæces should be carefully dislodged. The sphincter muscle is often excessively irritable and painful under these conditions. The use of an anæsthetic will then be found most advantageous.

Purgatives in such cases are not of much use, until the load is somewhat reduced in the lower bowel.

The following very instructive case is mentioned, in a letter to Dr. Burne, by the late Dr. R. Williams, Physician to St. Thomas's Hospital. A lady, aged 35, was attacked with severe gastrodynia, and most obstinate constipation. Paroxysms of pain recurred at short intervals, gradually became more frequent, and at length quotidian. Each meal was followed by pain so severe and continued that she limited herself to dry biscuit and brandy-and-water; and this was commonly rejected. Nothing gave relief but opium, of which, for months, she took not less than sixty grains daily. Her bowels, independent of the astringent effects of opium, were always greatly constipated; and no quantity of salts, oil, or senna in the least moved them; elaterium, croton-oil, or other powerful purgatives immediately inverted the action of the stomach, and were rejected. Calomel was the only medicine which would act upon the bowels, and this not until her mouth was affected.

From this cause she frequently had no evacuation for *six weeks* together; and in one year, when much weakened by repeated salivation, so that it was necessary to defer the administration of the calomel as long as possible, she had only one evacuation every *three months*, or *four in the year.*

At the times her bowels acted she suffered immensely, her pains being more severe, if

[1] *Path. Trans.* vol. v. p. 174.

possible, than those of labour. The fæcal matter when passed was enormous in quantity, healthy in colour, and was formed into large round lumps or scybala, each certainly not less than a large fœtal head, and so numerous as often to fill a common-sized pail.[1]

We may, perhaps, have travelled somewhat from the path of our especial calling, in introducing the latter cases, illustrative of chronic obstruction of the intestine. But the accumulation of large quantities of fæces is often productive of a strange and anomalous train of symptoms; often such as indicate structural obstructions; or simulate morbid growths in the abdominal cavity, and even retention of urine from pressure on the urethra, &c., as occurred in a case under the author's notice, in which the rectum was enormously distended by hardened fæces. Experience, discrimination, and careful examination are often requisite to insure a correct diagnosis as to the true nature of these collections: and without extreme caution, the surgeon may be baffled in his attempts to unravel the conditions attendant on a loaded intestine, accompanied by obstinate constipation. With a gut greatly distended by fæcal matter, and with the symptoms of organic obstruction, it will frequently happen that the bowels act freely, and yet without relief, or any reduction of the size of the abdomen. It is but the over-shot of the sluice: the head-stream is dammed up; the canal is loaded to over-flowing.

2. Obstruction, the result of injury, we need but allude to here. The conditions and treatment have been already described; see Vol. I. Injuries of Abdomen.

3. Constipation, occasionally amounting to obstruction of many days' standing, or even of a fatal character, is apt to occur in cases of peritonitis, attendant on tubercular deposit in the subserous cellular tissue, or the result of other causes; a condition often accompanied by ulceration of adjacent and adherent surfaces of the intestine.[2] A direct communication thus takes place between two or more opposed surfaces of bowel; often an abscess is found within the abdomen, communicating through ulcerated openings with several portions of the intestinal canal; there is great irritability of the stomach, and often rejection of all food; an unyielding abdominal wall and an irregularity of its surface; general but not exquisite tenderness; and constipation of, perhaps, some days' standing. Such symptoms might at first sight convey the idea that obstruction was due to some of the causes previously enumerated. But in such cases as we have now under consideration, there are usually general indications of tuberculous cachexia long before symptoms of obstruction set in. The conditions of the bowels is, however, as a rule, extremely uncertain in these cases: occasionally confined, but more frequently relaxed. With adhesion of peritoneal surfaces, and ulceration through the coats of the intestines, obstruction is rare; and is rather the exception, unless the calibre of the bowels is contracted by the pressure of abscess, or diminished by false membrane, or other media, stretched across the tube. Looseness of bowels is the usual condition in the cases just considered.

4. Stricture of the intestine is the most common cause of obstruction.

Strictures of the intestine occur under various conditions, independent of cancerous deposit in the walls of the gut. The chief causes of simple stricture are due to the action of caustic substances; to the presence of foreign bodies, causing ulceration and contraction; to tuberculous and syphilitic ulceration; to ulceration of the mucous membrane without any known cause; to the thickening attendant on an old reducible hernia; and to an inflammatory action taking place in the walls of a portion of the intestine, terminating in the effusion of fibrine, and subsequent contraction of the canal.

Stricture the result of disease of the upper portion of the small intestine is rare. We believe, when met with, it usually follows cicatrisation and contraction after ulcer, the direct effect of some escharotic swallowed; or of some other form of ulcer which, in healing, has narrowed the diameter of the gut.

Stricture of the duodenum is uncommon. We have met with a few instances of it. In the Museum of the College of Surgeons is a specimen of a stricture of the duodenum; the stricture is half an inch in length. It appears simple in its character, but has no history attached to it.[3]

[1] Burne, *On Habitual Constipation*, p. 28.
[2] An interesting case is recorded by Dr. Bristowe, *Path. Trans.* vol. viii. p. 200.
[3] Series xxiii. No. 1176.

The following case well illustrates the effects of an escharotic substance introduced into the stomach. A woman, aged 40, accidentally swallowed about half a wineglassful of 'Burnett's solution' (chloride of zinc), and was immediately seized with violent pain and vomiting; but under treatment recovered from the immediate effects of the poison. A month afterwards, pain and vomiting returned; and in about two months after she was admitted into St. Mary's Hospital, under the care of Dr. Markham. All food taken was rejected; and she died about four weeks after her admission, and some three months after taking the fluid. In the pyloric portion of the stomach, about an inch and a half above the valve, the stomach was so contracted as only to permit the passage of a small bougie. The constriction was clearly the result of a cicatrix.[1]

A young lady had accidentally some 'Burnett's fluid' given to her instead of a dose of medicine. Acute pain and vomiting were the immediate result, and for many months life was despaired of; by degrees the stomach became more tolerant of food, and was able to retain small quantities of fluid nourishment, taken at frequent intervals. It is now many years since the accident; but the greatest care was at first requisite on the part of the patient with regard to diet. It could then only be taken in a fluid form, in small quantities; and was generally required at intervals of four hours. Solid meat, or indiscretion in quantity of food, produced vomiting. The health was in every other respect good. Probably some contraction had taken place from ulceration, caused by the caustic applied to the pyloric extremity of the stomach or to the duodenum. Of late years the patient has been able to take solid food.

Stricture following other forms of ulceration is occasionally met with. A specimen of stricture of the ileum after ulceration is recorded by Dr. Bristowe. The ileum and lower part of the jejunum presented numerous ulcers, mostly cicatrising. At the commencement of the ileum a cicatrix had formed, and reduced the calibre of the intestine to such a degree that the point of the little finger could barely be inserted. Below, the bowel was contracted; above, it was considerably dilated. One slough, opening through the intestine, allowed the escape of fæculent matter into the peritoneal cavity. The intestinal wall at the strictured part was an inch thick. Throughout the large intestine were numerous cicatrising ulcers. The history of the patient did not throw any light on the case. For some years she had been liable to sudden attacks of pain and constipation.

A man, aged 54, had been poorly for twelve months. At the commencement of that period he had suffered from an attack of fever, since which he complained of pinching pain in the bowels; the abdomen became swollen; and he lost flesh. He could take very little food; was constantly sick, but the bowels acted once or twice daily. A constriction of the ileum was found at the junction of the upper with the middle third, dependent on great thickening of the walls of the bowel. The stricture was an inch long, and barely admitted the tip of the finger. Immediately above this, the bowel formed a pouch, the parietes of which were thinned almost to perforation. In this pouch were found thirty-three plum-stones, and sixteen cherry-stones, all perfectly black; and half a dozen recently swallowed orange-pips. There was an oblique inguinal hernial sac, into which it was evident, from the position of the parts, that the strictured portion of the intestine had been in the habit of passing.[2]

These cases are interesting when we consider the causes of the strictures described. In the former, though there was extensive ulceration of the bowel above and below the stricture, the symptoms, and the nature of the latter, incline us to believe that contraction of the bowel from cicatrix was the primary disease. In the latter case it is most probable that inflammation, produced by the bowel frequently slipping into the old hernial sac, was the original cause of the stricture, quite independent of the attack of fever, or any ulceration of bowel following that attack.

In allusion to this consideration, viz. whether the ulcerations of intestine in fever are subject to contraction, and are thus productive of stricture, Rokitansky observes that the cicatrices 'have occasionally been observed thirty years after the fever had occurred'; and he adds, 'it is singular and characteristic of this ulcer and its cicatrix, that they never in any way give rise to a diminution of the calibre of the intestine.'[3]

Of the healing of ulceration, the result of tubercular infiltration, he further observes: 'In consequence of the contraction of the ulcer, a cicatrix forms on the surface of the intestine, which presents a more or less elevated ridge on the internal surface of the intestine. If the ulcer was of considerable size, or if it encircled the entire intestine, a callous annular ridge remains, which diminishes the calibre of the intestine, and when viewed from without occasionally gives rise to an appearance of invagination. Thus the healing of a tubercular intestinal ulcer is always accompanied by a diminution of the intestinal calibre.'[4]

[1] *Path. Trans.* vol. x. p. 164.
[2] *Ibid.* vol. x. p. 154.
[3] *Path. Anat.* vol. ii. p. 73.
[4] *Ibid.* vol. ii. p. 96.

So, also, in the ulceration of the bowel under attacks of dysentery, he observes: 'In case of extensive destruction of substance, the approach of the edges is rendered impossible; the deeper layers of the tissue, which takes the place of the mucous membrane, is frequently condensed into fibrous bands, which form corded projections into the intestinal cavity, interlace with one another, and not unfrequently encroach upon the calibre of the intestine, in the shape of valvular or annular folds, thus giving rise to a stricture in the colon of a very peculiar form. This mode of regeneration is more remarkable, as it closely resembles that following the destruction of the œsophageal mucous membrane by mineral acids.'[1]

A case of stricture of the sigmoid flexure, near its junction with the rectum, is reported by Dr. Peacock.[2] The contraction was apparently due to the cicatrix of an old ulcer. There was much thickening, puckering, and induration of the internal tunics. There was no appearance of any cancerous deposit. Immediately above the stricture the cavity of the intestine was very large, and an ulcerated aperture of sufficient size to admit the passage of the thumb existed on the anterior and inner side; a portion of fæcal matter had escaped into the cavity of the pelvis.

5. Obstruction is too often the result of stricture, dependent on cancerous deposit in or about the walls of the intestine. The ultimate effects are equally fatal. Their treatment must vary according to their conditions: and life may be even prolonged many months with proper care and judicious management.

Cancer of the intestine occurs most frequently in the large bowel. When the small intestine is affected, usually the disease has attacked it secondarily, having originated in some contiguous tissue. The nature of the deposit varies much in different cases: epithelioma, true scirrhus, medullary deposit, or villous growth, will each be met with; the former more frequently than any other form of cancer; but, as Rokitansky justly observes, they 'may be combined with one another, from their first origin, or consecutively.'

'The colon,' he continues, 'is almost exclusively the seat of cancerous degeneration; but there is a gradation in the proclivity of its different sections to the affection. The rectum is most frequently attacked; in second order, the sigmoid flexure; and the remaining portion of the colon but rarely. . . . Carcinoma occurs as a primary affection of the intestine in three forms. Firstly, in the mucous membrane, as carcinomatous infiltration of the erectile tissue, into which the former has been previously converted—fungus; secondly, more frequently in the submucous cellular tissue, as round nodulated accumulations; thirdly, most commonly as an annular deposit of the cancerous tissue in the submucous cellular layer.'[3] And he adds that 'cancerous stricture of the intestine is the most common variety of stricture that results from alterations in the intestinal coats, and at the same time the one that advances to the highest degree.'

Out of a total of thirty-one cases of stricture of the intestines examined after death at the Middlesex Hospital, in no fewer than twenty-seven was the disease situated in the large intestine. Of the remaining four cases, in one it involved the ileo-cæcal valve; in another the ileum at its lower end; in a third, the upper part of the ileum: and in the fourth the jejunum. Out of thirty-two cases recorded in the Pathological Transactions, thirty-one involved the large bowel alone, and one the lower end of the ileum and cæcum. In fifty-eight cases out of sixty-three, the seat of stricture was in the large bowel. In round numbers, nearly three fourths of the cases of stricture involved the lower end of the intestine, the number met with in the sigmoid flexure and in the rectum being practically equal; whilst of the remaining one fourth, the ascending colon is the rarest, and the cæcum the next rarest seat; the remainder being equally shared by the regions of the transverse colon and the descending colon.'[4]

[1] *Path. Anat.* vol. ii. p. 87. [2] *Path. Trans.* vol. xiii. p. 97. [3] *Ibid.* vol. ii. p. 97.

[4] *On Strictures of the Intestine*, by Sidney Coupland, M.D., and Henry Morris, M.A., F.R.C.S. Read in the Section of Surgery at the Annual Meeting of the British Medical Association, 1877.

The following case illustrates the history of such a stricture :—

A man, aged 58, was admitted, under the care of Mr. Birkett, into Guy's Hospital, with constipation, which had existed for a week. Twelve months previously the patient had been attacked with diarrhœa, sickness, and great pain over the whole of the abdomen. The diarrhœa ceased, but the attacks of sickness and pain recurred at intervals. He lost flesh. The bowels were sometimes costive, at others relaxed. He became gradually worse in every respect, and then sought admission into the hospital. At this time he had constant nausea; frequent vomiting every two or three hours, and always after taking food. The abdomen was tense, but not tympanitic. There was a swelling in the right inguinal canal, but no hernia could be detected. Two days after his admission, as the symptoms were not relieved, Mr. Birkett cut down upon the old hernial sac; but no intestine was found in it. The symptoms became gradually more distressing, and the patient died about four days after admission. The right flexure of the colon was constricted, as if a string had been tied round it. 'Within this constricted part, a growth was seen attached to the anterior wall of the bowel; and was of the nature described by Rokitansky as "villous cancer."'[1]

Malignant, or cancerous deposit, productive of stricture of the intestine, though usually found to affect persons past the meridian of life, may occasionally be met with in youth.

A boy, aged 15, was the subject of a stricture of the rectum from three to four inches from the orifice of the bowel. The stricture was very tight, and accompanied by ulceration of the mucous membrane. The stricture was caused by the deposit of medullary cancer external to the muscular fibres of the gut. The patient died of acute peritonitis.

The author performed colotomy in the left loin in a gentleman, under 30 years of age, for obstruction of bowels caused by extensive cancerous deposit in and around the walls of the rectum, with considerable contraction of the gut. The patient was greatly relieved for some weeks by the operation. He then became the subject of ascites, and for this was tapped several times. After the fourth tapping he sank rapidly. On examination after death, extensive and general deposit of cancerous tubercles were found in the sub-serous tissue of the visceral, as also of the parietal peritonæum in addition to the extensive cancerous deposit in the walls of the rectum.

Advanced age generally appropriates to itself those forms of intestinal obstructions which take their origin in cancerous deposits. From the pylorus to the ileo-cæcal valve, from the cæcum to the rectum, there is no portion invulnerable to their attacks. Occasionally they are found to affect the duodenum; somewhat oftener the jejunum and ileum; most commonly the lower portions of the large intestine. If medullary stricture be found in youth, the rectum is almost invariably the seat of the mischief.

Spasmodic strictures, as they are termed, appear to depend on disordered or costive bowels, and need no comment here.

The symptoms attendant on obstruction from other causes will vary according to the completeness of the strangulation, or block.

In twists of the large bowel; simple stricture, or cancerous contractions; foreign bodies; loaded intestine: abscess of abdomen; and other chronic causes of impediment, the symptoms may vary to some extent, and in most of these instances may present themselves less suddenly.

Constipation, more or less difficulty in defæcation, small long thin or flattened motions occasionally interrupted by passage of loose evacuations, some blood, mucus, or even pus, constitute the primary and alarming symptoms of commencing stricture of the large bowel. The belly becomes distended by degrees, as the obstruction increases; pain follows upon the increase of contents; often transient periods of diarrhœa occur. The commencement of vomiting depends somewhat on the position of the obstruction. If in the upper portion of the intestinal canal, it will occur early, and distension of the abdomen will be less marked. If in the lower bowel, sickness sets in late, but great accumulation may occur in the large gut, and the peritoneal coat be in consequence ruptured before death, unless timely relief be afforded.

The examination of the general surface of the abdomen does not often convey

[1] *Path. Trans.* vol. iv. p. 154. The preparation is illustrated by an excellent engraving in the *Transactions*.

[2] *Ibid.* vol. i. p. 67.

much, if any, idea of the exact seat of the obstruction, unless it be caused by a tumour in that cavity. Occasionally, with a twist of the sigmoid flexure, the chief swelling has been observed on the left of the umbilicus; but very little dependence can be placed on such evidence as a solution of the exact cause or seat of the obstruction. The examination of the rectum often conveys more satisfactory information. The obstruction may be frequently here detected by the finger, or bougie; water thrown up may be immediately returned, or a small quantity may be retained, sufficient to indicate that a stricture, not to be detected by the finger, exists higher up.

A long tube passed up the rectum may enable us to detect the actual obstruction; but it is often apt to deceive us as to the seat of the stricture. It is, however, desirable, in all cases of obstruction, to attempt its introduction as far as possible without any force, and to inject warm water frequently and plentifully as long as fæcal discharge accompanies the return of the injected fluid.

The emaciation which usually accompanies cancerous deposits in other parts, the existence of fæcal fistulæ in the abdominal wall, the bladder, or the vagina, are symptoms and conditions of occasional occurrence in cancerous stricture. But as in the larger majority the disease is of the epitheliomatous character, the local effects are more frequently and immediately the cause of death than the constitutional contamination, or secondary infection. Hepatic pains of previous years, or months, the symptoms of former mischief about the gall-bladder, point towards the supposition that a biliary calculus may have ulcerated into the duodenum, and produced the obstruction by blocking up the canal. Concretions, the offspring of particular kinds of food, the stones of fruit, or substances swallowed under peculiar conditions of hysteria or mania, produce similar symptoms of obstruction.

The treatment of obstruction of the bowels is a question of the deepest interest. There is too frequently a hopeless condition when the surgeon is called in. Death occurs often so early in the scene, even in a constitution otherwise healthy, that not unfrequently the medical attendant has little time to propose, or the patient to acquiesce, in measures which may prolong life; it becomes therefore a matter of grave importance to decide upon rules for our guidance under such perplexing circumstances.

In the early management of this class of cases, purgatives should be scrupulously avoided. This is a precaution to be adhered to most rigidly. But, as already observed, the golden rule to guide us in the treatment of cases of obstruction is that opium be administered by the mouth, and aperients only by the rectum. Every rule may have an exception; but experience has taught us that, whenever this one has been departed from, subsequent occasion for regret has arisen. Hot fomentations should be applied to the abdomen, especially if pain or tenderness exist. Enemata should be used frequently and in large quantities, especially if it be suspected that the obstruction is the result of impacted fæces.

The introduction of the long tube may be attended by some difficulty, but, if successful, secures a most efficient administration of enemata. The use of the latter may occasionally prove injurious. In a case of twist of the sigmoid flexure, the fluids injected in the usual manner were retained. Subsequent to death, it was found that a long tube could be inserted beyond the twist into the dilated bowel; but in consequence of a flap-like entrance at the commencement of the latter, the fluid introduced could not return. Enemata should consist of warm water, or oil, mixed with castor oil, but their mechanical action is of more importance than their specific properties.

In the management of every case of supposed intestinal obstruction, every variety of solid food should be rigidly prohibited. Life should be entirely sustained by fluid nourishment.

When situated low down in the sigmoid flexure, or upper portion of the rectum, the obstruction will be more readily detected, as the accumulation in the larger bowel increases. In such conditions it is prudent, if practicable, to overcome the immediate effects of obstruction, by passing a small gum catheter through the stricture, and injecting warm water into the bowel; or by introducing the finger gently and slowly

into the gut above, to dilate slightly the contracted part. In the latter attempt much care is necessary. The passage of the finger should not be hurriedly or hastily effected. The stricture in these parts is commonly the result of some form of cancer; the parts are consequently thickened, often ulcerated, and brittle under manipulation. The duration of the disease has allowed it, probably, to implicate the whole structure of the surrounding gut, and has often involved the peritonæum in the diseased mass. As the bowel, from the load above, is pressed down far lower than its natural relations, the peritoneal reflection in consequence comes much nearer the external aperture; a sudden dilatation of the diseased bowel, a rapid thrust of the finger through the obstruction, can only be effected at the expense of some laceration of the diseased tissues.

A man was admitted into St. George's Hospital, under the care of Dr. Nairne, with constipation of some days' standing. Treatment having failed to procure any action of the bowels, the author was requested to make an examination of the state of the rectum. This was found pushed down so that the orifice was on a level with the lower edge of the nates. A stricture was readily felt, within a short distance of the anus, pressed down, however, by an immense collection of fæcal matter. A small gum catheter was introduced without difficulty, and allowed the escape of some fluid fæces and flatus, with great velocity. The forefinger was subsequently passed very slowly through a rather resistant contraction of the bowel, the result of large deposit around it. The man shortly had great desire to pass a motion, and a copious evacuation of fluid fæces took place; but while on the close-stool, he was seized with excruciating pain, which continued for some time. He died the following morning. The intestines were greatly loaded, especially the lower bowel. In the pelvis, recent effusion of lymph and fæculent extravasation were observed. A small rent in the peritonæum on the anterior face of the rectum, just above the recto-vesical fold, ran through the diseased (cancerous) mass into the cavity of the gut; a rent no doubt made in the wall of the bowel during the dilatation of the stricture by the finger. Through this rent the fæces had passed into the cavity of the peritonæum.

We have now to discuss the conditions under which it is justifiable to operate in obstruction of the intestines, when all other efforts have failed to procure relief.

The duration of constipation is not *the positive* indication for such interference. Death takes place in three or four days, if perfect strangulation of the bowel has occurred from the pressure of a band of false membrane, or from intestine having slipped through some contracted aperture in the omentum or mesentery. In such a case, vomiting is the most important symptom. Vomiting is *the* symptom, which of itself indicates the absolute necessity of active interference, and the hazard of delay. In common or cancerous stricture of the rectum, constipation is not often complete or continuous, although the accumulation of fæces may be great. Six weeks or two months may elapse without a motion, and without fatal results from such an occurrence. Constipation here again is not alone *the* symptom which warns the surgeon to interfere with his knife. In constipation following peritonitis the result of injury, in habitual or other accidental constipation, the bowels may remain locked up for a month, or even two, and yet ultimately yield to treatment or time, and recovery take place. Constipation in the latter instances cannot, therefore, be taken as *the* signal for the establishment of an extraneous outlet to the contents of the bowel.

But in the more acute instances of strangulation, with vomiting, pain, and distension, complete constipation must be present to justify operative interference. In the more chronic instances of obstruction, provided the distension be not very great, so long as fæcal ejections can be secured in never so small a quantity, the means to encourage them must be persevered in; and operative measures should be delayed.

In the treatment of all forms of obstruction dependent on structural derangement or organic disease, medicines are of no avail. If the obstructing cause be not removed, or if the condition of the intestine be not relieved by some effective measures, the patient will surely die, and in a comparatively short time.

'Internal strangulation,' observes Rokitansky, 'when diagnosed, most imperatively requires an operative proceeding, for the purpose of disentangling and arranging the intestines, and for the division of the strangulating structures.'[1] In one (Littre's) the abdomen has to be opened by cutting through the abdominal wall

[1] *Path. Anat.* vol. ii. p. 54.

into the peritoneal cavity. In the other (Amussat's) the intestine has to be reached by cutting down on it in the lumbar region external to the peritonæum. The alternative of cutting into the abdomen for the relief of obstruction in the small intestine, or of opening the colon in the loin for stricture of the large bowel, must always, at the best, be regarded as a choice of evils. A patient is suffering from the effects of some internal stoppage which will surely destroy life in a few days; or from a disease which, by causing obstruction, will prove fatal in the course of a few weeks; unless, in the former, the stoppage be overcome; or, in the latter, the effects of the disease be obviated for a time by an artificial outlet above the seat of stricture. But in either case the operation is not to be considered any but a serious one; especially so when it is necessary to open the peritoneal cavity. The gravity of this operation is increased in proportion to the youth of the patient; in infancy it is one attended by very great danger to life. Again, its gravity is also increased by every hour of delay permitted after the symptoms of acute strangulation or obstruction manifest themselves. In the other case there is the suffering entailed by distension, unrelieved bowels and vomiting, diminished nourishment, and last, though not least, the danger of ulceration of the mucous membrane from distension and pressure, and subsequent perforation; or from the distended state of the bowel rupture of the peritonæum, to be followed shortly by the giving way of the muscular and mucous coats. All these circumstances have to be well considered by the surgeon before he can arrive at any satisfactory conclusion as to the amount of immediate relief an operation may confer, or as to the ultimate advantage of any surgical interference. If operation be decidedly considered advisable, any delay in its execution is always an element of danger; and invariably in all cases the earlier it is had recourse to the greater the prospect of benefit.

In strictures of the rectum, sigmoid flexure, or transverse colon, the operation for relief is confined to either lumbar region, from whence the intestine may be opened, where it is uncovered by peritonæum. The advisability of this operation can generally be carefully weighed before it is necessary to perform it; for there is usually less urgency of symptoms in cases which require it than in strictures higher up; and often a period of a week or two may be permitted to elapse, provided the patient be carefully watched, before operation is absolutely requisite.

The conditions which demand it are, continued and unyielding constipation, distension of the abdomen, and commencing irritability of the stomach, or actual vomiting.

The conditions which forbid us to anticipate recovery, and therefore should negative surgical interference, are, shrunken countenance, feeble and quick pulse, cold or clammy skin, and general tenderness of the abdomen, superadded to the symptoms enumerated above.

The operation of opening the peritonæum for the examination of strangulated or obstructed intestine, and for the formation of an artificial anus in the walls of the abdomen, was first advocated and adopted by M. Littre, in modern times at least; though the abdomen had been opened by Pillore of Rouen in 1776, and an artificial anus formed in the cæcum, for cancerous obstruction of the rectum.[1] The operation of M. Littre is thus described: 'Il faudrait faire une incision au ventre, et recoudre ensemble les deux parties après les avoir rouvertes, ou du moins faire venir la partie supérieure de l'intestin à la plaie du ventre, que l'on ne refermerait jamais, et qui ferait la fonction d'anus.'[2]

This operation, originally proposed for the relief of imperforate anus, is that to which we can alone have recourse to relieve any form of internal strangulation, or obstruction dependent on mischief *confined to the small intestine.*

It is not desirable to adopt this operation in obstructions *confined to the large intestine.* The operation which insures the opening of the ascending or descending colon, commonly termed the operation of Amussat, is alone to be adopted in these cases.

[1] 'On Artificial Anus,' *British and Foreign Medical Review,* vol. xviii. p. 452. The author begs to acknowledge the assistance he has received from the perusal of this most able essay.

[2] *Hist. de l'Acad. des Sciences,* 1710, p. 36.

When obstruction is known to be situated in the rectum, or suspected in the sigmoid flexure, the descending colon must be opened; when suspected in the transverse or descending colon, the ascending colon, or cæcum, must be cut down upon. The exact seat of stricture may occasionally be ascertained—if in the rectum, by the introduction of a finger or a bougie; if in the sigmoid flexure, it is often made manifest by swelling, thickening, or hardness of the part. The stricture is less evident externally, when seated in other portions of the colon. It then often becomes mere speculation at which part of the bowel the obstruction is seated.

No experience will enable a surgeon to decide positively in all cases as to the exact position of the stricture. The distension of the bowel may in some cases interfere with the detection of a tumour, should one exist; fulness in the left loin, which in many cases can be taken as an indication of the distension of the descending colon, may be really due entirely to that of the small intestine forced into the lumbar space, and covering over a contracted descending colon, while the stricture may be situated in the transverse or ascending colon. Careful examination of the rectum may give nothing more than negative evidence: while fulness and distension in the left loin must not necessarily be taken to indicate distension of the descending colon. In three instances under the author's observation, the evidence was such as to justify an opinion that the seat of obstruction was in the sigmoid flexure; and consequently the descending colon was opened in each. It turned out that in two of the cases the seat of obstruction was above the aperture made in the bowel, but within reach of the finger; in the third case it subsequently proved to be in the transverse colon. In each of these cases the patient was turned over to the left side, an incision at once made in the right loin, and the ascending colon being found distended was opened and treated in the usual manner.

The chronic nature of the symptoms, and the slow accumulation of fæces, must always point to the large bowel being the seat of mischief; but when symptoms render it doubtful whether the obstruction lie in the transverse or descending colon, the safe course is to open the ascending colon. The author has seen enormous dilatation of the ascending and part of the transverse colon follow on stricture of the left extremity of the latter portion of the large bowel; in one instance, to such an extent as almost to convey the impression that a large tumour might have been pressing on the bowel, and thus produced the obstruction; so very uncertain are the conditions in some cases with which the surgeon has to contend.

The operation of opening the colon was first advocated by Callisen,[1] but attempted by him only on the descending colon. M. Amussat modified it by extending it to the ascending colon. To him alone is due the credit of having revived the operation—an operation which had not only fallen into disuse, but was condemned as dangerous and impracticable.

The advantage of this operation is, that it enables the surgeon to expose the intestine and open it, where it is uncovered by peritonæum, and where it lies in front of the quadratus lumborum muscle, and merely separated from that muscle by cellular tissue. The situation of the external incision, on either side, is in the lumbar region, between the last rib above, the crest of the ilium below, a vertical line running from the end of the rib to the crest of the ilium in front, and the edge of the longissimus dorsi behind. The colon in this space is fixed to the abdominal wall by the reflexions of the peritonæum, and lies loosely in contact with the quadratus lumborum. The kidney is situated rather above the seat of the incision. There is no meso-colon here; and if the colon be much distended, the cellular space between the folds of peritonæum will be very conspicuous. It is at this part that the intestine should be opened.

Callisen advocated a vertical incision for this purpose in the loin; Amussat has judiciously recommended a transverse one. The advantages are thus fairly stated: 1st, that it makes the operation easier and more certain, and avoids the danger of dividing the lumbar vessels and nerves; 2nd, that it facilitates finding and opening

[1] *Systema Chir. Hodiern.* tome xi. p. 842, Hafniæ, 1817.

the intestine without wounding the peritonæum; and 3rd, it enables us to establish the artificial anus more anteriorly.[1]

The incision should commence in front of the longissimus dorsi, and be carried forwards to the extent of about six inches. The integuments having been divided, the muscles are to be carefully cut through until the intestine is exposed. This is not a difficult or troublesome proceeding. The intestine, especially if loaded, presents its muscular surface in the bottom of the wound, uncovered by peritonæum. The bowel should be at once hooked up by a curved needle; two or more points should then be secured by threads to the margins of the wound, and the gut opened. Usually a gush of fluid fæculent matter now takes place; ample provision should therefore be made to secure it as it flows out, to prevent the bed becoming soiled, which would be the case in a few seconds, if suitable basins be not at hand to apply to the edge of the wound.

The intestine should be allowed to empty itself gradually. The relief to the patient is often at once very considerable; but he should be steadily watched, and well supported, as faintness is very apt to follow upon the rapid evacuation of the long distended bowel; or should peritonitis have set in prior to the operation, the patient will soon sink. Should he survive the operation, the treatment of the wound is of next importance. In the first instance much inconvenience and even some distress may be experienced from prolapse of the gut through the artificial opening; especially if the latter be a free one. But as the wound in the integuments has a natural tendency to contract as time advances, and the margins of the intestinal opening become adherent to the former, the prolapse will gradually diminish in proportion to the contraction, and will usually cease ultimately when the orifice becomes fully contracted. Indeed, should the patient's life be prolonged, it will be found as a rule that the surgeon's attention must be directed towards maintaining the freedom of the artificial opening sufficiently to insure the escape of the contents of the bowel. In the first instance the escape of fæcal matter through the wound may be controlled by the use of an ivory ball or plug attached to a small shield, on which a piece of india-rubber sheeting may be placed, and fixed in its position by a bandage. As the wound continues to contract, it will be found best to substitute for the ivory plug a piece of sponge-tent: this may be introduced and worn in the opening day and night, but changed morning and evening. Its use has been found to effectually control the escape of air and fæcal matter.

Sometimes the patient will experience discomfort from the accumulation of fæces between the strictured portion of the bowel and the artificial opening; or from the contents of the bowels becoming too solid to pass freely through the aperture, and therefore care must be taken to regulate the action of the bowels with gentle aperients as circumstances indicate.

The operation of opening the colon in the lumbar region is an important measure, not only for the prolongation of life in cases of total obstruction from stricture of the rectum; but also for the mitigation of suffering in cases of ulceration and stricture of the rectum without actual obstruction. In such cases excruciating pain is often experienced when the bowels act, from the passage of fæcal matter over the ulcerated surface; and it has been found that, by establishing an artificial opening above the seat of disease, and thus diverting the passage of fæces, and leaving the stricture at rest, great comfort has been conferred upon the sufferer.

Mr. Curling was the first to advocate this operation under such circumstances, and he has frequently adopted it with much relief to the patient's sufferings while life lasted. He recommends previous to the operation that the bowel should be injected with fluid in order to distend it to some extent, as when in a distended condition the bowel is more readily detected and secured than when empty and contracted.

Mr. Holmes[2] has published the particulars of a case in which he opened the descending colon for the relief of a patient in whom there was a fistulous communication between the sigmoid flexure of the colon and the bladder. The symptoms were immediately relieved, and

[1] Amussat's *First Memoir*, p. 241.

[2] *Trans. Med.-Chir. Soc.* vols. xlix. and l.

the patient remained free from the passage of fæcal matter into the bladder for about fifteen months, when fæces again appeared in the urine. He shortly after this died, and on post-mortem examination it was found that besides the communication between the sigmoid flexure and the bladder, there had formed a more recent communication between the bladder and the cæcum.

In ten cases reported by Mr. Curling, the patients survived over periods varying from two to eighteen months. In a case under the care of the author, and in which complete obstruction had existed nearly three weeks, the patient survived the operation over two years and a half. The artificial opening had always a tendency to close, but was kept open by the use of sponge-tent.

The entire removal of a stricture of the large intestine by operation, colectomy,[1] is a subject worthy the most careful consideration of every surgeon, who may have to deal with cases of obstruction, the result of contracted bowel, due either to cicatrix or to cancerous or other growths originating in its walls.

Mr. Thomas Bryant, Surgeon to Guy's Hospital, deserves the thanks of the profession for having recently discussed this question, in an interesting communication to the Medico-Chirugical Society in the session 1881–82. The result of a case operated on by him proved so satisfactory that we have every reason to hope his example and success may be an encouragement to others to undertake the operation, provided circumstances appear to render it justifiable or promising in its results.

To enable the reader to appreciate fully the nature of the operation adopted by Mr. Bryant, we record the particulars related by him, though in a somewhat abridged form.

A lady, æt. 50, had suffered from complete obstruction for eight weeks, and was in a very feeble state of health. The abdomen was greatly distended. The stricture could not be detected through the rectum, nor could any tumour be discovered in the abdomen after the most careful examination. Under these circumstances, Mr. Bryant decided to perform colotomy in the left side.

After the bowel was opened, the stricture was detected by the finger introduced through the opening in the colon. As the diseased portion appeared to implicate but a small extent of bowel, and not to be complicated by surrounding adhesions, or extension of growth beyond the surface of the bowel, Mr. Bryant determined to attempt its removal. He found it practicable to draw the strictured portion through the external wound, and then removed the whole mass involving the intestine: stitching each portion of the bowel, as divided, to the lips of the external wound. The stricture was of the annular kind, and involved about one inch of the bowel. It was so narrow as barely to admit the passage of a No. 8 catheter.

In the operation the edges of the upper portion of the opened intestine were carefully secured by numerous sutures to the external wound; and subsequently the lower portion dealt with in a similar manner, so that the margins of the upper and lower extremities of the divided intestine were approximated in the wound. The precautions taken prevented any escape of fæculent fluid into the peritoneal cavity. The patient was greatly relieved by the operation, and steadily recovered without any unfavourable occurrence. She remained well more than six months after the operation, and reported herself to be much improved in health. The artificial opening was treated in the usual manner.

In some observations in connection with the case, Mr. Bryant observed that he considered this operation was applicable to not a few cases of stricture of the descending colon. It had suggested itself to his mind from seeing cases of localised or annular stricture of the bowel, which were free and movable, both in operations of colotomy as well as in the post-mortem room. He also very justly remarked that these annular strictures were generally local diseases, and consequently that it was desirable they should be removed where possible. He considered that the question of excision should be entertained as soon as the diagnosis of the case was made; and that in every case of colotomy for chronic obstruction of the descending colon, the possibility of being able to remove the diseased bowel should be considered before the bowel is opened. He also pointed out how desirable it was that the question of excision or of colotomy should not be postponed till the patient's powers were too feeble to bear either operation, as unfortunately is too frequently known to be the case.

Since the publication of Mr. Bryant's case of colectomy, a second has been reported by Mr. Marshall,[2] Surgeon to University College Hospital.

[1] See New Sydenham Society's *Lexicon*, 1882.
[2] *Lancet*, May 6, 1882, p. 721.

In the latter instance the abdomen was first opened in the median line. The diseased portion of bowel was however found towards the lower end of the descending colon, so that it could not be readily removed through the aperture in the anterior abdominal wall. An incision was subsequently made in the left loin, and the diseased mass of bowel removed through the latter opening. The open end of the upper portion of the divided intestine was then secured to the edges of the external wound by sutures; while the upper end of the lower portion of bowel 'was left projecting from the lower and hinder part of the wound, with a strong catgut ligature drawn tight upon it.' The anterior wound was closed in the usual way.

The patient was under the influence of ether for quite an hour and a quarter. She had been greatly reduced by a long illness, having shown symptoms of intestinal disturbance some nine months prior to the operation—repeated attacks of constipation, vomiting, and much colic. Her condition was, so far, unfavourable for any operation. Though she rallied for a short time, symptoms of peritonitis terminated in death on the third day. The post-mortem conditions are of interest. 'The abdomen was moderately full; the wound in the mid-line was united by first intention, except at the skin between the lowest two stitches; no adhesions existed between it and the intestines. There was diffuse peritonitis starting from the lumbar wound, and the hollows of the abdomen contained some thin blood-stained puriform fluid, with flakes of lymph in it. One or two coils of small intestine were adherent, by recent lymph, in the left loin; and the descending colon was similarly attached to the parts about the wound. On raising it, a small collection of pus was opened, and from the cavity containing it a finger passed easily out between the bowel and the edge of the lumbar wound; but elsewhere the union between these parts was tolerably firm. There was no sign of extravasation of fæces. There was very little in the intestines; the wall of the whole colon above the line of excision was much thickened, and its mucous membrane had a uniform deep-brown colour. From this up to the œsophagus the alimentary canal was normal, no ulcer or scar could be found. The liver was small, and on its surfaces, chiefly the upper, were fourteen yellow-white new growths, most of which were covered by thickened peritonæum, containing visible vessels: most of these were distinctly umbilicated. Many other growths were scattered through the substance of the organ. They varied in size from that of a small chestnut downwards. On section they were grey-white and firm, with centres made up of spots of soft opaque yellow material. Each was surrounded by a bile-stained ring. No other secondary deposits were discovered.'

'The diseased mass, which was removed with a piece of the intestine, was about one inch and a quarter long, and so thick as to leave a channel through it only as wide as a No. 8 catheter. Its thickness was uniform all round the gut. It formed not an annular but a short cylindrical stricture. Its epitheliomatous character was undoubted. A microscopic examination of a nodule in the fresh liver showed the growth to be a columnar epithelioma.'

Although the above-recorded cases are probably the only ones in which attempts have been made to remove stricture of bowel by operation in this country, several operations have been performed on the Continent within a somewhat recent period, though not altogether with very satisfactory results.

Since the time when Littre advocated opening the intestine in the left groin for the formation of artificial anus in cases of congenital malformation or exclusion of the rectum, the attention of surgeons has more or less been drawn to the importance of endeavouring to remove, by operation, the various causes of obstruction. But the more effective method of treating strictures by removal may be said to date within the last fifty years or less. The subject is one of so much interest that we think it right to relate in a short summary the more recent results in this field of surgery.[1]

In 1833, an operation for excision of an abdominal growth with part of the colon, through an incision above and parallel with the crest of the ileum, was performed by M. Reybard of Lyons. The tumour was removed with three inches of intestine; and the divided ends of the latter joined by suture. On the third day the external wound gaped; but had healed on the thirty-eighth day, and the action of the bowels had become natural. Six months after recurrence of growth commenced, and death took place ten months after the operation. There was no post-mortem examination to explain the condition of the intestine, or to account for the manner in which the restoration of the passage of fæces was accomplished. Some doubt is thrown on the accuracy of the details of this case.

Another attempt was made by Gussenbauer of Liège, in 1877. He first made an incision in the median line, but, as it was not possible to remove the growth through this opening, a transverse incision was subsequently made from the above, as far back as the lumbar fascia. The tumour was partially attached to small intestine, which was torn in the endeavour to liberate the diseased portion. This mass, with about three inches of colon, was removed.

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[1] We are indebted to Mr. Marshall's able communication to the *Lancet* for drawing our attention to the references here given.

Fæces escaped into the peritoneal cavity. The wound of small intestine was closed, and the ends of the divided bowel brought together by suture. The patient died in fifteen hours.

In a second case recorded by the same surgeon in 1879, an exploratory median abdominal section was completed subsequently by lumbar colotomy. The patient died on the third day. An annular cancerous stricture of sigmoid flexure, with large attached mass, in and behind rectum, was found after death.

The small intestine was opened above Poupart's ligament by Baum of Dantzic, in 1878, in a case suffering from obstruction, but in which he could not satisfy himself of an overloaded *large* intestine. Seven days later, the distension having been relieved, a slightly movable tumour could be felt below the right hypochondrium. The peritonæum was again laid open by a longitudinal incision over the tumour, about two and a half inches to the right of the mesial line. From this a transverse incision was afterwards made, directed towards the right side. The growth was connected with the ascending colon, near the commencement of the transverse portion. The tumour with three inches of intestine was removed. The open ends of the intestine were passed one into the other, and secured by sutures. On the seventh day severe pain commenced, and death occurred on the ninth day. The examination after death showed that the edges of the meso-colic portion of intestine had united; but the upper part was gaping, and communicated with a large cavity connected with the loose cellular tissue around the kidney, but did not communicate with the peritoneal cavity. The growth removed was of a cancerous character, and had blocked the passage of the bowel.

In another case, the abdomen was opened by Martini of Hamburg, for the removal of a tumour felt in the left side, the lower end of which could be detected in the rectum. It was found to implicate the sigmoid flexure. It was readily drawn into the wound, and removed with four inches of the intestine. It was found impossible to approximate the separated ends of bowel. The upper end was attached to the skin as in colotomy, while the lower was invaginated within itself, closed with sutures, and returned into the abdomen. No severe symptoms followed the operation; in two months the patient returned to his business.

A very interesting case is one in which two separate portions of intestine were removed by Czerny of Heidelberg, in 1880. When the peritoneal cavity was opened by anterior abdominal section, a growth was found to be connected both with a portion of transverse colon and sigmoid flexure. First a piece of the latter, two inches and three quarters long, was removed, and the divided ends stitched together; secondly, about four inches and half of the transverse colon was removed, and the divided portions brought together by suture. The operation lasted two hours and a half. The subsequent progress was satisfactory. On the eighth day fæces escaped through the wound, and continued to do so to the twenty-sixth day. On the tenth and thirteenth days copious relief took place, naturally, and daily evacuations subsequently. The external wound slowly healed, but the cicatrix soon assumed a hardened condition, and the patient died of recurrent disease, some seven months subsequent to the operation. There was extensive cancerous deposit in the course of the descending colon and sigmoid flexure, and other deposits in liver.[1]

In analysing the evidence afforded by these cases, it will be observed that in three of them the sigmoid flexure was the seat of disease; in one, the descending colon was affected; in one, the ascending colon; and in one, the transverse colon and sigmoid flexure were both affected. Incision into the peritoneal cavity by anterior abdominal section was made in all of these cases; in four the divided intestine was brought together by sutures and returned into the abdomen; in one artificial anus was established, and in one the operation was ended by subsequent performance of colotomy and artificial anus.

In the cases in which the intestine was returned into the abdomen, one is reported to have lived some time after the operation, one died in fifteen hours, one on the ninth day, and one seven months after the operation, escape of fæces having occurred through the external wound subsequent to the removal of the stricture.

In the case in which an exploratory incision was made and colotomy subsequently performed, death occurred in fifteen hours. In the case in which artificial anus was at once established after abdominal section, the patient recovered sufficiently to resume his occupation for a time.

In this analysis the results of the cases published by Mr. Bryant and Mr. Marshall are not included; they are referred to hereafter.

The question which naturally arises from the experience now before us is, whether it were better, in the first instance, to have recourse to lumbar colotomy in any case of obstruction suspected to arise from disease of the large intestine, to be followed by colectomy in such cases as may appear suitable for such an operation; or whether an

[1] We beg to refer the reader to Mr. Marshall's communication for further particulars of this case. See *Lancet*, May 9, 1882.

anterior abdominal opening into the cavity of the peritonæum should be decided on for the removal of a diseased and strictured portion of intestine.

Another question also demands our serious consideration: whether it were better, subsequent to the removal of the diseased portion, that the ends of the divided bowel be fastened together by suture and returned into the abdomen; or that an artificial anus be established in the first instance, as after the operation of colotomy.

The operation itself of removing any portion of the intestinal canal must ever be regarded as a most serious undertaking. It can only be requisite in a case in which the local disease has already to some extent marked its effects on the patient; this may be, and often is, associated with cancerous deposit elsewhere; often not externally evident, frequently not suspected; and may be so surrounded by adhesions or outgrowths that its removal becomes an undertaking of difficulty, and consequently of no small hazard. The operation can only be justifiable when there is a hope that in its performance the mass can be readily and entirely removed, without incurring more than the usual risks attendant on such an operation, and with a fair prospect of prolonging life.

We have already pointed out that in a considerable proportion of cases of obstruction of the larger bowel the disease is situated in the descending colon and sigmoid flexure, and that in a very large proportion of cases in advancing life the disease partakes of the nature of epithelioma.

These facts rather point to the advantages offered to the operation of colotomy in the first instance, even though only adopted as a means of investigation when our diagnosis as to the seat of obstruction is at fault.

With all the modern improvements in operative surgery it must, however, be ever accepted that abdominal section for the relief of a loaded bowel, with its surrounding complications, is a far more serious undertaking than to open the bowel in the loin. And every surgeon of experience will allow that, to open the abdomen, to remove a portion of bowel, to connect the divided ends by suture, and to return the bowel to the cavity of the abdomen, is a far more formidable and hazardous operation than to cut down on the loin, to open the bowel, if feasible to remove the cause of obstruction through the lumbar incision, and finally to establish an artificial anus.

In many cases it will be found impossible to decide at what exact spot the seat of obstruction is placed. The disease may be too high to be detected by the finger in the rectum; the abdomen may be too distended to allow of the mass being felt externally; or the diseased portion may be too small to be distinguished by touch, even were the intestine not much distended. This is no theoretical statement: it sums up the results of general clinical experience.

Taking all the evidence brought to bear on this question, it appears to us that the safest practice in a great majority of cases would be to open the colon in the loin; whether the right or the left side be selected must of course depend on the evidence in each case, as well as on the judgment of the operator. As it has often occurred to us, so it will not unfrequently happen to others, that after the bowel has been exposed in the loin, and opened, the seat of mischief has been detected by the fingers, and much more satisfactorily examined as to its surroundings, than could possibly be the case prior to the incision in the loin.

In illustration of this statement, we may mention a case in which, as soon as the bowel was opened, the stricture was detected just above the opening in the descending colon. It was so tied down that it would have been more than hazardous to have attempted its removal. Colotomy in the right loin was subsequently performed, and free escape of fæces followed.

The circumstances of this case suggested to us, at the time, the possibility of removing a stricture of the colon, and the subject was subsequently discussed with some of our colleagues at St. George's Hospital, but no opportunity had since occurred to test its applicability. The particulars of the case published by Mr. Bryant offer strong positive evidence in support of the views now put forward, while the facts related by Mr. Marshall in reference to this operation we consider equally favourable to the practice suggested.

The other important question remains to be considered: how to deal with the divided bowel after the diseased portion has been removed, whether it were better to stitch the ends together and return the intestine into the abdomen, or to form an artificial anus as in simple colotomy.

The evidence appears to us to be greatly in favour of establishing an artificial anus, rather than to return the stitched bowel into the abdomen.

It must always be borne in mind that the above remarks apply only to treatment of stricture of the large bowel. If removal of a portion of small intestine be desirable, we cannot doubt the propriety of invaginating the upper into the lower extremity and uniting them by suture. Moreover in such a case there will not arise a doubt as to the necessity of anterior abdominal section.

In some cases, after removal of a portion of the large intestine, it may be found that the divided ends of the bowel cannot be made to approximate. In such circumstances there can be no alternative but the establishment of an artificial opening. Still another difficulty may decide the question for the surgeon. The bowel above the stricture in a case of obstruction is often greatly thickened, not unfrequently much soddened and softened, so that the walls will readily tear under the most careful manipulation, while on the other hand the lower bowel is often contracted to such an extent, that time and care may be requisite to dilate it sufficiently to accommodate the upper portion. Mr. Marshall has alluded to this difficulty. This contrast between the condition of the portions above and below the stricture must be familiar to all who have had much experience in cases of colotomy.

Let us take then the evidence before us, and what is likely to be the opinion of surgeons, as to whether the bowel should be returned into the abdomen after the divided ends have been made continuous, or whether the operation should end in the formation of an artificial anus?

The following points placed before the practitioner may somewhat serve to guide him in his practice that in many instances the cause of obstruction is a small mass of disease confined entirely to the walls of the bowel, often without secondary complication; that the disease in a large majority of cases is epithelial in character; and in a considerable proportion attacks either the ascending colon or sigmoid flexure; that the disease frequently kills, by ulceration and perforation at the seat of stricture or elsewhere, the result of pressure and distension; and, lastly, that, when epithelioma can be completely removed, it may possibly not recur, or some time may elapse before its reappearance;—with all these facts before us, it must be conceded, that following on colotomy, the removal of the diseased mass of bowel is not only justifiable, but should be attempted when circumstances are in favour of such operation; the removal to be attempted first through the lumbar opening; but should this not be practicable, then by an extension of the wound. But, by whatever external wound the diseased portion of large intestine be removed, we should decidedly prefer to complete the operation by establishing an artificial anus, than have recourse to the alternative of returning the united ends of bowel into the abdominal cavity.

When the strictured portion has been drawn towards or outside the external opening, so that the bowel can be fixed to the external opening, safety ligatures may be placed above and below the portion to be removed; each should be tied sufficiently tight to prevent escape of contents when the diseased portion is severed from the healthy parts. The edges of the upper extremity should be attached to the margins of the external opening as soon as convenient, and for this purpose we recommend the continuous suture. If the safety ligature be not employed, the intestine may be stitched to the external opening to a very considerable extent, if not entirely, before the diseased mass is removed. Care must be taken that the contents of the bowel do not enter the peritoneal cavity. The edges of the lower extremity should be secured as near as possible to the margins of the upper extremity, and then the external wound contracted by suture as much as necessary, care being taken that the opening in the peritonæum is entirely closed. This being done, nothing remains but to treat the case simply as one of colotomy.

If the surgeon decide to bring the divided ends of the bowel together, and unite

them by suture, the upper portion should be placed within the lower, and secured by continuous suture. The entire edge of the lower bowel should be *inverted*, and so fixed by the sutures, in order to secure the contact of two serous surfaces. The ends of the suture, fastened and cut short, will in time ulcerate and fall into the bowel, should the patient recover.

On the Removal of the Pylorus for Cancer.

The removal of the pylorus for the relief of cancerous or simple stricture must always be considered one of the most formidable operations in surgery. In the first place, the diagnosis as to the extent of the disease must always be difficult, if not in a great measure imperfect; the structures to be dealt with are complicated by their surroundings; and the operation itself, under the most favourable circumstances, must be tedious in execution, even in the hands of the most skilful operator, and consequently exhausting to one already much reduced by partial starvation.

That the pylorus is a common seat of cancer, and that the stricture caused by the latter rapidly destroys life, by its interference with nutrition, are facts well known to all familiar with the disease. With regard to the liability of the pylorus to cancer, Rokitansky remarks, 'the pylorus, indifferently at all parts of its circumference, is known to be the chief seat of primary fibrous and areolar cancer of the stomach.

'From this point the degeneration extends chiefly along the lesser curvature over the pyloric half of the stomach. It is singular that cancer of the pylorus is accurately bounded by the pyloric ring, and never extends to the duodenum. The scirrhous pylorus is commonly bound down by the tissues that lie behind it; but exceptions occur which require the more to be known as they materially affect the diagnosis. The degenerated pylorus may remain unattached, and will then, owing to its increase in weight, descend to the lower region of the abdomen, even down to the symphysis pubis, causing a hard, very movable tumour, which easily gives rise to mistakes.

'In proportion as the parietes increase in size and thickness, the stenosis of the pyloric channel will be more or less considerable; nodose protuberances, uneven contraction of the tissues, and corrugation of the parietes, give rise to inflections presenting a more or less acute angle. The greater the stenosis, and the more the cancerous degeneration is limited to the pylorus, the more considerable will be the dilatation of the stomach, which sometimes reaches to an enormous size, and presents a more or less hypertrophied state of its muscular wall.[1] Dr. Wölfler[2] mentions that among 903 cases of gastric cancer, the disease started in 542 from the pylorus; but of these it was found at the post-mortem examination that in 233 there were no cancerous nodules. Still more important is the fact that in 172 instances there were no adhesions to the neighbouring organs.'

Before the surgeon can undertake, or even contemplate, the performance of the operation for removal of the pylorus, it is imperative that the diagnosis of the case should be most carefully and thoroughly considered. In the first place, to facilitate the means of arriving at a correct conclusion as regards the nature of the disease and its surrounding complications, if any exist, the patient should be placed under the influence of an anæsthetic. The tumour should be readily felt; the extent should be limited; the mass should be freely movable; and jaundice should be absent. But, with the most careful examination, although it may result that all the most desirable conditions exist, there may appear complications when the parts are exposed which would entirely defeat all attempts to remove the diseased pylorus. Indeed, it may be fairly laid down as a principle, if this operation is to be undertaken, that no one can decide on its completion until the exploratory incision has been made, and either the hand introduced into the cavity of the peritonæum to ascertain the relative conditions of the diseased mass, or it is found that the mass itself can be drawn out through the opening and more fully examined externally.

[1] *Manual of Pathological Anatomy*, vol. ii. p. 43. Published by Sydenham Society, 1849.
[2] See Billroth's *Clinical Surgery*. Translated by Clinton Dent, F.R.C.S., and published by New Sydenham Society, p. 494.

Let us, however, take what may be considered a favourable case for removal; a case in which the surgeon is satisfied that the disease of the pylorus is entirely confined to the walls of the part; without adhesions to surrounding viscera, and free from complications connected with the stomach, what are the precautions to be taken prior to the operation, and what should be the steps of the operation itself?

Billroth[1] recommends that when the mass is distinctly felt, and all external circumstances are considered so far favourable for the removal of the pylorus, that the patient is to be prepared for the operation by having the stomach washed out with tepid water several times previous to the day of its performance, and thoroughly so two hours before the operation is commenced. Should the stomach, however, be greatly dilated, it will be found a rather difficult matter to do this completely. The bowels should also be attended to the day previous, but in the class of cases under consideration the intestines are usually somewhat empty.

The steps of the operation are thus described by Billroth:—'An incision should be made through the abdominal wall over the situation of the tumour. If the cancerous pylorus has sunk down particularly low, it should be raised up before the incision is made.' A transverse incision from four to five inches in length should be made over the seat of the tumour, and before the peritoneal coat is divided every bleeding point should be secured. The peritonæum is then to be opened, and the parts surrounding the diseased pylorus examined as to adhesions. He advises, if the cancer be found adherent to the pancreas, that the idea of removal should be abandoned, and the external wound closed; so also as regards the transverse colon, or if the cancer had extended over the horizontal part of the duodenum.

'As soon as the condition of the parts has been made out, the stomach is drawn up to the wound, and examined to see the point at which it must be cut through; and then to commence the removal of the pylorus with the portion of stomach and duodenum immediately adjoining.' To begin with, the large omentum is detached from the greater curvature, and the gastro-colic ligament cut through. The layers of omentum are taken up between two clip forceps, which form grooves just suitable for the application of silk ligatures. The tissue is cut through in the middle between the ligatures; or, still better, burnt through with the thermo-cautery. This is not, however, always necessary, for by means of blunt forceps the great omentum may be detached without any hæmorrhage; the lesser omentum is then separated in the same way. In detaching the omentum, enlarged lymphatic glands may be met with requiring removal. During the entire operation the portion of the stomach which it is intended to replace must be covered by cloths which have been soaked for fourteen days in a five per cent. carbolic solution. When the part to be resected is completely exposed, the most disagreeable and difficult steps are over. After the stomach has been isolated, a large, flat, disinfected sponge or cloth should be laid beneath the viscus, so that the further manipulations may be carried on with ease and care. By gently lifting out the stomach as far as is necessary, all further proceedings may be conducted outside the peritoneal cavity. The sponge and cloth will prove a valuable protection if any contents left in the stomach escape when it is cut into.'

To attach the duodenum to the lesser curvature of the stomach, 'the tumour should be seized by the vulsellum; the walls of the stomach are cut through with scissors, commencing at the greater curvature. After each stroke of the scissors, any bleeding points are secured; about two-thirds must be divided. If it is found that the stomach is not completely empty, the contents should be soaked up with a sponge specially reserved for this purpose. All vessels are ligatured with fine antiseptic silk, and the cut edges of the stomach so united together that the serous coats are applied to each other.'

'The cancerous pylorus is now connected to the intestine alone. If there is any fear lest the duodenum should slip away when the division is completed, a few silk threads may be passed' to secure it, and Billroth recommends a small sponge to be inserted temporarily into the duodenum.

With respect to the insertion of the duodenum into the stomach, he says, 'we

[1] *Op. cit.*

must begin at the posterior walls of stomach and duodenum. A very good plan of uniting them is to insert the posterior sutures before the duodenum is completely separated. In our first case the stomach was cut away. and then the upper half of the duodenum. Several threads were then carried through the walls of the stomach and duodenum to form the posterior "ring suture," and were then given to an assistant to hold while the occlusion sutures were being inserted.' The posterior walls of the stomach and duodenum are to be first united by passing the sutures from within outwards to secure the contact of two serous surfaces; then the anterior portion is to be dealt with in the ordinary way.

Billroth makes some remarks about various kinds of sutures employed in this operation to connect the stomach with the duodenum; but it appears to us that the continuous suture is more applicable for this purpose than any other; it is most easily carried round the entire wound, and can be readily adapted to ensure the approximation of the edges of the wound in the most complete manner, and so retain them more perfectly than any number of uninterrupted sutures, however carefully applied. One of its great advantages is the extreme simplicity of its application, and the more rapid, as well as more complete, approximation of the edges of a long wound. If, however, a long single continuous suture were used to complete the approximation of the whole circumference of the wound, in this instance it would be apt to act slightly as a ligature round the orifice of the duodenum, and so occasion obstruction after the operation had been completed. To avoid such an occurrence, it is only necessary to knot the suture after every three or four stitches, or to use three or four separate sutures; the former is the simplest and a perfectly effectual mode of using the continuous suture; but, when used in attaching the duodenum to the stomach, it must be borne in mind that the suture has to escape through the bowel, and a very long one might be some time becoming perfectly detached, or inconveniently long to escape readily through the intestinal canal; therefore it would be well to use three or four to secure the duodenum to the stomach, one following the other. Whatever can in the least degree contribute to shorten the period of the operation, in one of such gravity, must be regarded of some importance, and certainly the continuous suture can be applied in a much shorter time than the usual number of interrupted sutures required here.

When the edges of the two cut surfaces have been adjusted and united by suture, the external wound should be treated in the usual manner.

It is remarked by Billroth, 'when all the sutures had been inserted in the first case, we were not a little astonished at the excellent shape of the new-formed stomach, which was almost normal in appearance. The greater and lesser curvatures were somewhat flattened. In our second case, therefore, we saw no reason to alter the plan of attaching the duodenum to the lesser curvature. In consequence, however, of an immense dilatation of the stomach in this case, and the greater extent of the cancer, which rendered it necessary to modify the direction in which the duodenum was divided, a diverticulum formed, as will be described presently. Profiting by this experience the following plan was adopted in the third case—the duodenum was attached to the greater curvature of the stomach, in order to guard against the formation of a diverticulum, and to provide for the more ready passage of the gastric contents.' 'Under all circumstances it is desirable to divide the stomach obliquely, in order to prevent the formation of a diverticulum.'

The diet after the operation is a point of great importance in the after-treatment. All patients, the subjects of cancer of pylorus, who submit to the operation for its removal are invariably sure to be in a greatly reduced condition prior to undergoing it, or may be at death's door from previous and long inability to take sufficient nourishment. Consequently great judgment is required in its administration. A tablespoonful of fresh milk every hour may be given during the first twenty-four hours, provided there be no vomiting, and nutrient enemata, with small doses of laudanum, should be administered every four or six hours. After the first day, if all goes well, the quantity of milk may be increased, and subsequently the fluid supple-

mented by more solid food, should the condition of the patient permit or indicate such a change of diet.

Removal of the pylorus was first performed by Péan of Paris, in 1879.[1] The patient died in five days. More recently the attention of surgeons has been drawn to the subject by the operations performed by Professor Billroth of Vienna, and a few other continental surgeons.

The first case operated on by Billroth was a patient, æt. 43. 'In the umbilical region could be felt a hard, easily moveable tumour, painful on pressure, and about the size of a small fist. The pyloric end of the stomach, with a portion of the duodenum, was removed. The duodenum was cut from above, and the stomach was obliquely divided. Four vessels in the stomach required ligature. All the sutures were cut short, and left in the cavity of the abdomen. The operation lasted one hour and a half. The part removed measured five and a half inches long at the lower border, and four inches along the upper border. The pyloric opening was so narrowed that a probe could with difficulty be passed through. The tumour was an alveolar colloid cancer, and a similar morbid growth was found in the lymphatic glands.'

The progress of the case was favourable. With the exception of a feeling of weight during the first twenty-four hours, the patient had no particular subjective sensations. The abdomen kept flaccid, there was no vomiting, and from the very first flatus passed abundantly. During the first day the patient had nothing but ice; on the second day, a coffee-spoonful of acid milk every hour; subsequently sweetened milk, and then gradually coffee, &c. On the twentieth day after the operation the patient was able to eat a cutlet.

'During the first twelve days the state of the bowels gave rise to some anxiety. Although the patient ate comparatively little, still large quantities of fæces were passed, but so hard were they that the nurse had sometimes to scoop them out with her fingers.' 'The motions were so white and chalk-like, that we feared that the functions of the bile were not properly discharged. As soon, however, as the patient began to take solid food, the stools (at the end of the second week) again became of a brown colour, and the fæcal masses diminished in size.' Mr. Clinton Dent, the editor of the English edition of Billroth's work, reports in a note that this patient died about four months after the operation. 'The post-mortem revealed cancerous degeneration of the peritonæum, and infiltration of the retro-peritoneal lymphatic glands. The form of the stomach was similar to that of the normal organ.

The second patient, operated on by Billroth, was 39 years of age. The operation was very similar in its details to that already described. It lasted two hours and three quarters. The pylorus was filled up by a cancerous mass, its opening just admitted the top of the finger. The growth was ulcerated on its surface, and proved to be an epithelial cancer.

The patient died on the eighth day after the operation. The morning after the operation the patient vomited; and again on the fourth day bilious vomiting took place. There was no distension; flatus passed, the wound was satisfactory. Pulse 112 to 120. 'Evidently the gastric contents did not flow into the duodenum; and evidently also there was no complete stenosis where the "ring sutures" were applied, for bile was present in the vomit. Suspecting that a quantity of fluid might have collected in the flaccid sac of the stomach, we drew off the contents, and evacuated about 200 grammes (nearly 8 ozs.) of yellowish sour fluid. Attempts were made to restore the functions by the administration of good wine and meat, but all in vain; the greater part was thrown up again in a few hours. By the next day we were restricted to giving nutrient enemata. Thinking that a diverticulum might have been left in the stomach, and that some obstruction must exist which had not been present before the operation, for the patient had never previously vomited, and had always been able to take fluid food, Professor Billroth adopted the last resource which the circumstances seemed to indicate. The wound was re-opened, and the occlusion sutures cut. The index-finger, passed into the stomach, could only with difficulty be introduced into the duodenum. The anterior ring sutures were also divided, and the wall of the duodenum attached to the abdominal walls, a drainage-tube being passed into the gut for the administration of food. The patient was very pale, and collapsed after this operation, which lasted an hour. She died on the following day.'

The post-mortem showed no general peritonitis, but only general anæmia and marasmus.

In a third case, the cancer of the pylorus was found to be attached to the pancreas, and consequently the operation was rendered more tedious, as 'the isolation of the pancreas alone occupied about an hour.' The entire operation lasted two hours and a half. The patient was much collapsed during the operation; frequently retched during the afternoon, and died the same evening.

The growth removed proved to be medullary cancer. The opening of the pylorus just admitted the finger. Cancerous glands were found near the head of the pancreas, and in the lesser omentum. In addition there was old tuberculosis of the apices of the lungs, and miliary tubercle on and about the pleura.

The fourth case related was operated on by Dr. Wölfler. The patient was 52 years of

[1] *Gazette des Hôpitaux*, No. 60, 1879.

age. The tumour was about the size of an apple, and freely moveable in every direction. The operation appears to have been attended by no difficulties.

'The patient was perfectly free from reaction after the operation. She had no fever, vomiting, or symptoms of peritonitis.' For the first nine days she was able to partake of meat. The operation was performed on April 8, 1881. On June 28, the patient was reported as 'perfectly well, and as able to take all kinds of nourishment without harm.' She was kept under close observation, but no trace of recurrence had, up to date, been discovered. Such are the cases and their results, as related in the work referred to. In the 'British Medical Journal,' July 1, 1882, p. 22, a case is reported to have been operated on by Professor Caselli, of the University of Genoa. The operation appears to have been performed in the manner recommended by Billroth. It occupied two hours and a half. The portion excised measured four inches and a half in length, by three and three-quarters in breadth. The patient sank from shock a few hours after removal to the ward. A post-mortem examination showed the viscera free from cancerous infiltration. The nature of the growth removed is not reported.

Professor Czerny of Heidelberg, at the Medical Congress held in London in 1881, related a case in which he had excised the pylorus—a man, æt. 28, 'who had suffered from symptoms of disease of the stomach for fifteen weeks, and who for the last ten weeks had been so reduced by vomiting, in spite of the methodical use of the stomach-pump and careful feeding, which, however, gave him temporary relief, that his weight had been reduced to ninety-four pounds. Still he was able to get about; and to this circumstance alone I attribute the good result of the operation. The stomach was enormously distended, the great curvature of which reached actually to the pubes, and contained a tumour in the neighbourhood of the pylorus, as large as a child's fist, tender to the touch, and changing its position considerably, according to the greater or lesser distension of the stomach.' An incision was made, four inches long, in the middle line; the stomach was drawn out, and an incision made into it; the entrance to the duodenum was found to be completely obstructed by hard, knobby excrescences, which seemed to confirm the diagnosis of carcinoma. The diseased mass was removed in the manner described. The operation lasted more than two hours. The mass removed proved to be cancer with small alveoli, starting from sub-mucous tissue, involving the muscular coat, but leaving the mucous membrane intact.

The wound healed without a sign of inflammation. The patient took soup on the second day, meat on the fifth, and got up on the twentieth. In the next fourteen days he gained eleven pounds in weight, and had returned to his occupation when these particulars were given.

Professor Czerny also related, on this occasion, the particulars of a case operated on by Professor Nicolaysen of Christiana. A woman, æt. 37, suffered from pain in the region of the stomach, which at last became so severe, and the vomiting so constant, that she was completely deprived of sleep. The pylorus was excised in the manner recommended by Billroth. The operation lasted two hours and a half, although no difficulties presented themselves, the tumour being freely moveable. The patient died collapsed, fifteen hours after the operation.

Professor Czerny remarked, in reference to these two cases, that he considered this operation for the removal of the pylorus as one of the most recent advances in intra-peritoneal surgery, but one which sceptics still regard with a good deal of suspicion. He considered that excision of the pylorus ought not merely to be confined to cases of cancer, but that a great future is opened up by it for those cases of simple stricture of the pylorus in which an incurable dilatation of the stomach is found, an argument already put forward by Gussenbauer and Winniwarter.

The results of the cases above alluded to have now to be examined. We find that two may be considered as complete recoveries after the operation, that the disease was removed, and life prolonged for a time, and that the patients were alive and well some few months after. Czerny one, Wölfler one. In one (Billroth) the patient recovered from the effects of the operation, but died four months after from recurrence of disease. In one (Billroth) the patient died on the eighth day. In one (Nicolaysen), in another (Caselli), and in a third (Billroth) the patient succumbed from the effects of the operation. In one (Péan) the patient died on the fifth day.[1]

These facts are interesting and important, and perhaps may be considered sufficiently encouraging to justify, if not to stimulate, surgeons to undertake the removal of the pylorus when the seat of growth and stricture. The symptoms to justify the attempt should be the free mobility of the diseased portion, and the continued suffering and emaciation of the patient. It must at all times be doubtful how far the disease may affect surrounding parts; this point can only be decided by an explora-

[1] Whilst writing these pages, we see a case reported in the *Brit. Med. Journ.*, July 29, 1882, by Mr. Southam of Manchester. The patient died of shock.

tory incision. If, then, the disease be found limited to the pylorus, it would be right to attempt the removal of the mass, in the manner recommended by Billroth. The disease left to itself will surely kill, and that with much suffering, and in a short time. The operation may prove fatal, but it offers a chance of life to one who cannot long survive if no operation be undertaken, and it would be well that the patient should decide on the benefit of the doubt. The emaciated condition of patients who suffer from stricture of the pylorus is, to some extent, an advantage in the operation. There will arise no complication from superabundant fat: the walls of the abdomen will be thin; the omentum will be but a fine thin membrane. But emaciation must not be permitted to run too far. Patients suffering from any interference with nutrition rapidly fail in power, and in such conditions especially the words of Macbeth apply with trebled force as regards the operation—'if it were done, when 'tis done, then 'twere well it were done quickly.' Procrastination is danger when once the disease is detected and the operation considered applicable; whilst early removal offers a better prospect of success, inasmuch as the patient may be better able to withstand the shock of the operation. The operation itself has proved a long one in the hands of the most skilful; whatever will aid to shorten it will be a gain to the patient; we therefore again urge the trial of the continuous suture, rather than the use of the interrupted one, as more rapidly applied, and as thoroughly efficacious.

Mr. Lawson Tait [1] has published a case in which he removed a large impacted gall-stone from the dilated bile-duct. The edges of the cyst were connected to the edges of the parietal wound by continuous suture. The patient did well. A similar operation was performed by Dr. Marion Sims in Paris, in 1878, which did not, however, prove successful. Mr. Lawson Tait [2] also mentions having applied the operation of abdominal section in five cases of hydatids of the liver, and in one of large cystic abscess of the same organ: all these cases recovered.

The Operation of Tapping; Paracentesis Abdominis.

When the abdomen becomes inconveniently distended with fluid, contained either in the peritoneal sac or in an ovarian cyst, it is desirable to relieve the patient by tapping the cavity in which the fluid is lodged.

Previous to the operation, the patient may be placed upright on the edge of a chair, or recumbent on the side of a bed. A broad towel, warmed, should be passed round and above the umbilicus, and a second one below; the ends of these towels should be held behind the patient, and tightened as the fluid escapes from the abdominal cavity, in order that a certain amount of support be afforded to the viscera when the whole of the fluid is abstracted. Previous to the introduction of the trocar, a catheter should be passed into the bladder and the urine drawn off. A small incision should first be made through the skin, about two or three inches below the umbilicus, just sufficient to permit the passage of the cutting surfaces of the trocar. This proceeding allows it to be passed readily into the abdomen, and with less pain than if the trocar is thrust through the integument. The trocar should be pushed nearly up to the hilt of the cannula, and the stilette then withdrawn, and care taken that the cannula does not slip out after it. The fluid will now escape freely; if serous in character, and the cavity will soon be emptied.

If the patient become faint during the flow of the fluid, a finger may be applied to the orifice of the cannula to arrest the escape, while some stimulant is administered, and until faintness passes off. The common trocar, with short cannula, is the simplest implement to use in this operation, and as efficacious as any; but of late a tube of india-rubber has been adapted to the cannula, so that the fluid may be carried to a basin at the foot of the chair or bed which supports the patient.

It sometimes happens that, after a certain quantity of fluid has escaped, the flow suddenly ceases, while there is still much remaining in the cavity; this is occasioned, probably, by intestine or some other substance coming in contact with the inner

[1] *Med.-Chir. Trans.* 1880.
[2] *Transactions of Medical Congress*, 1881, vol. ii. p. 229.

extremity of the cannula; the obstruction may be remedied by either moving the position of the cannula, or introducing a blunt-pointed but perforated tube, with which each case of trocars should be provided.

The large accumulation of fluid in the cavity of the peritonæum, or in an ovarian cyst, usually pushes the anterior abdominal wall so far forward that a considerable interval intervenes between it and the surface of the intestines; so that when the trocar is introduced, there is little risk of wounding the bowels. This is, however, an accident which occasionally happens, and therefore it behoves the surgeon to make a very careful examination of the surface of the abdomen, before proceeding to operate; if any tympanitic resonance be detected near the umbilicus, or below it, the operation had better be postponed or avoided. Mr. Gay exhibited at the Pathological Society a specimen of a portion of the jejunum, which had been punctured in the operation of tapping, in a case of ascites; but the patient survived the accident, and died three months afterwards, apparently from the disease which produced the ascites.[1] The wound caused by the trocar should be dressed with lint and plaster, and a bandage applied over it, round the belly. In a few days the parts have usually healed.

GEORGE POLLOCK.

[1] *Pathological Trans.* vol. ii. p. 203.

HERNIA.

PART I.

PATHOLOGY AND TREATMENT OF HERNIA IN GENERAL.

AN escape of any viscus from the cavity in which it is naturally placed is termed a hernia; but the observations in this essay are exclusively restricted to protrusions of the abdominal viscera. In common language this disease is called rupture. Our object will therefore be to describe the varieties of hernia developed in the different regions of the abdomen, their pathology and treatment.

The whole subject is divided into two parts.

The first embraces general considerations in relation to the statistics, pathology, and treatment of the disease.

The second is devoted to an examination of the special regional varieties of hernia, their anatomical characteristics, ætiology, diagnosis, prognosis, and the treatment especially adapted to each kind.

Sex.—Both sexes are afflicted with hernial protrusions. After carefully considering the statements of writers in relation to the numerical proportion in which the two sexes are subject to hernia, we must admit that we have not the requisite data to enable us to arrive at any satisfactory conclusion. We may, however, broadly state the fact that hernia occurs more frequently in males than females. Out of a gross total of 96,886 applicants for trusses at the City of London Truss Society, the males were 78,394, the females 18,492. After a careful consideration of all the circumstances, Mr. Kingdon estimates the proportion at two males to one female, for all ages and including every variety of hernia.[1]

Frequency of hernia at different ages.—The only trustworthy facts relating to the various ages at which hernial protrusions are first developed have been collected by Mr. Kingdon. In the reports of the City of London Truss Society for the years 1860 and 1861, he has tabulated 9,296 cases of inguinal and femoral hernia. All these patients passed under his personal examination, and the respective age of each individual when the hernia developed itself was ascertained as accurately as possible, by reckoning back to the age at which it was first noticed. Observers have been before this occupied in attempts to ascertain the ages when protrusions most frequently occur; but they have uniformly noted the ages of the persons at the time of their appearance before them. Accurate data were, under these conditions, never obtained; that is, if a knowledge of the age at which hernia is developed is to be regarded as a desideratum. Hence M. Malgaigne makes it appear that there are fewer cases of hernia before thirty-five years of age than after. This is a fundamental error, unless national peculiarities produce different results. The truth is, taking all varieties of hernia in both sexes, that the majority of cases are developed before thirty-five years of age.[2] I believe in the correctness of this fact, after having

[1] The proportion between males and females varies considerably at different periods of life, on account of causes connected with certain congenital malformations, which will be spoken of in treating of the special forms of hernia. Thus, in Mr. Kingdon's statistics for 1860 and 1861, there were in the first five years of life, 1,409 males, and only 107 females; while in the five years from 25 to 30 years of age, the proportion had changed to 846 males against 207 females.

[2] The following statements show the number of cases of hernia occurring at different ages, when the age of each patient was recorded by M. Malgaigne, at the time each one came

tested its accuracy as far as my means allow. It is, I know, directly in opposition to the received dogmas; but as we proceed we shall be able to assign very good reasons why hernia is so much more common before middle life than after that period.

Frequency of hernia in relation to population.—We have no trustworthy data on this subject. The general statements which have been advanced, in some of which the proportion is put as high as one in eight of the male inhabitants of the whole kingdom, and even one in five of the whole population of one district, do not rest on any precise information, and appear exaggerated.

Frequency of hernia in relation to age.—Mr. Kingdon's statistics (Table A) show that, out of 9,296 applicants for trusses, 1,516 were under five years of age. This would appear at first sight to show a much greater prevalence of hernia in infancy than during any other period of life. But this disproportion vanishes when we take into consideration the number of infants out of any given population. Thus, if we take Mr. Kingdon's table as giving an accurate idea of the numerical prevalence of hernia at different ages in London, we must compare the ratio between the number

TABLE A.—*Showing the Ages of the patients when the Hernia was first noticed.*

Age	1860				1861				Kingdon's Tables—Report of Truss Society, 1861–62. Age at development	
	Inguinal		Femoral		Inguinal		Femoral			
	M.	F.	M.	F.	M.	F.	M.	F.		
under 1 year	473	27	—	—	563	37	—	—	1,100	1,764
1 to 5	181	17	—	—	192	26	—	—	416	
6 „ 10	91	23	3	1	112	16	2	—	248	
11 „ 15	115	19	4	2	133	19	3	6	301	9
16 „ 20	284	27	3	14	291	38	8	15	680	
21 „ 25	348	30	18	31	375	33	13	37	885	1,938
26 „ 30	381	45	21	58	424	50	20	54	1,053	
31 „ 35	334	48	19	55	399	37	14	70	976	1,909
36 „ 40	320	38	18	59	373	41	16	68	933	
41 „ 45	271	31	30	47	268	24	11	49	731	1,377
46 „ 50	258	11	18	32	272	10	15	30	646	
51 „ 55	167	12	12	26	224	11	11	27	490	846
56 „ 60	147	6	9	16	151	4	8	15	356	
61 „ 65	97	6	10	11	110	3	7	12	256	379
66 „ 70	59	5	8	2	44	1	1	3	123	
71 „ 95	32	1	1	1	54	3	3	7	102	
	3,558	346	174	355	3,985	353	132	393	9,296	

of cases of hernia at any given age and the total number of cases of hernia, with the ratio between the number of the population living at that age and the total population. Proceeding in this manner, we shall find that, while there is no exact proportion maintained, yet the frequency of hernia slightly advances towards the latter end of life. Thus, taking the census of 1851, the total population of London of both sexes at all ages was 2,362,236; out of these, 293,562 were under 5 years of age: a ratio of 1 to 8·004. Out of the 9,296 which form Mr. Kingdon's total, 1,516 were under 5 years of age: a ratio of 1 to 6·13. Taking the next decade, we find the total number of the population between 5 and 10 to be 243,648, or in a ratio of 1 to

under his observation; and when the respective ages were carefully ascertained by Mr. Kingdon, to show when the hernia was first noticed. Out of 2,343 cases recorded by M. Malgaigne (*L'Union médicale*, 1854, p. 53), 555, or 23·6 per cent., were under 35 years of age; 1,788, or 76·4 per cent., above that age. On the contrary, out of 9,296 cases recorded by Mr. Kingdon, 5,659, or 60·8 per cent., had commenced before 35 years of age; and 3,637, or 39·2 per cent., after that age.

As the two tables exhibit such different results, I wrote to M. Malgaigne, who kindly returned the following polite reply

'Mon cher confrère,—La réponse à votre question:—les âges marqués à la page 53 (de *L'Union méd.* vol. viii. 1854) sont ceux des malades au moment où ils venaient à la visite du bureau central.'

9·69 to the total population; the number of cases of hernia, however, is only 248, or in the ratio of 1 to 37·08 to the total number of cases of hernia. Again, it was shown above that the absolute number of cases of hernia developed under 35 years of age was greater than that of those developed above that age, the proportion in Mr. Kingdon's table being 61 to 39. But in the census table the proportion of persons alive under 35 to those above that age is still higher, viz. 69 to 31. Therefore hernia is more common relatively to the number of the population above the age of 35 than under that age. It appears from calculation on these data, that 41 per cent. of cases of hernia are developed under the age of 35, and 59 per cent. over it.

The relative proportions of the different kinds of hernia at various ages and in both sexes, together with explanations of their occurrence, based upon anatomical and physiological facts, will be found in other parts of this essay.

The influence of occupations on the formation of hernia.—All persons, in every station of life, are liable to hernia. By far the majority of cases occur among the labouring class, which, abounding as it does in all large towns, affords a favourable opportunity to ascertain whether the pursuit of any particular trade or occupation involves a greater liability to hernia than another.

Mr. Kingdon has inquired into this subject with his usual care, and the results of the investigation are printed in the Report of the City of London Truss Society.[1] He has produced a table in order to compare the twenty-five largest classes of occupation, arranged in the order of their magnitude from the census of 1851, with the numbers of each class who applied to the Society during three successive years. This 'indicates that the patients who seek relief on account of hernia bear a direct proportion to the numerical magnitude of the classes to which they respectively belong, and not to the severity of the toil.'

The influence of hereditary conformation predisposing to the development of hernia.—A disposition to hernia may be inherited; that is, the children of ruptured parents are frequently afflicted in like manner. Mr. Kingdon has taken great pains to ascertain the proportion of cases in which this hereditary influence exists. In the reports of the City of London Truss Society for 1860–61, he has published the result of his inquiries. Both sexes show an equal tendency to be thus influenced. The proportion, by calculation, seems to be about 34 per cent. This hereditary predisposition, paternal, maternal, or on both sides, is manifested in the most marked degree with infants under one year; the cases being about 12 per cent. of the whole number in the first twelve months of life.

This fact points to two very important causes which give rise to hernial protrusions at this early age; first, to the arrested efforts of nature in closing the ventral orifice of the vaginal process of the peritonæum, and the obliteration of that sheath; and, secondly, to an abnormal elongation of the mesentery. Those two structural conditions belong to a class of anomalies very likely to be determined by hereditary influences.

Congenital defects of the parietes of the abdomen have been already mentioned as predisposing causes of hernia, and this subject will be further dwelt upon in discussing its various forms. Wounds, inflammatory lesions of the abdominal walls, and other predisposing causes may be mentioned. It is a question whether a portion of small intestine can reach the fundus of the scrotum, unless its mesenteric ligament be of preternatural length. For it is difficult to understand how the upper portion of the small intestine or the cæcum can descend so low as they are sometimes seen, without at the same time their mesenteric folds being elongated. But the fact to be accurately ascertained is whether the mesentery is abnormally long antecedent to the descent of the hernia; whether, in truth, a morbid elongation of the mesentery be a primary cause of hernia or not. Doubtless this structure becomes lengthened and stretched as the result of repeated or continued descents of the intestine; but we

[1] *Report*, 1861, p. 11.

are not cognisant of any facts to prove a congenital condition of the kind above alluded to. At first sight, this circumstance regarding the elongation of the mesentery may seem to have very slight practical value. Upon reflection, however, we shall arrive at an opposite conclusion. It has a very important bearing on the question of the radical cure of hernia, as it is termed. For if it be proved that the primary cause of any viscus protruding from the abdominal cavity can be traced to a morbid condition of its peritoneal retaining ligaments, the mere obliteration of the hernial sac can avail but little in producing the intended result of affording permanent immunity from the disease. That which often happens when a truss is used to support one kind of hernia would occur in this case also—namely, the development of another, perhaps even on the opposite side of the body; and thus any operation, even if successful in obliterating the first sac, would be of little value.

Persons in whom a hernial sac exists certainly state that they are more troubled with the descent of a hernia if they get out of health. This circumstance leads to the inference, that when the tissues generally are weakened and relaxed by indisposition, those which should maintain the viscus in its proper situation participate in the general morbid condition, and then permit the hernia to escape more readily.

It is equally certain, too, that persons constitutionally of a weak frame of body, whose contractile and fibrous tissues are deficient in tone and power, become more commonly subject to the development of a hernial sac as age advances, than those of an opposite conformation; always, of course, excepting those persons who have a congenitally open vaginal process of the peritonæum.

And further we may state, as the result of actual observation, that in both males and females of middle age the subject of hernia, the heavy abdominal viscera, the solid glands for example, are usually disposed in a much lower situation than their normal one; that, in fact, the abdominal viscera generally are not so firmly held in their proper places by their peritoneal ligaments as when no disposition to hernia is shown.

Between the muscular walls of the abdomen and the contents of that cavity a constant antagonism exists. The gaseous and fluid distension of the intestinal tube exerts an ever-variable pressure against the abdominal walls, whilst they, in their turn, react upon the inflated viscera; thus between these opposing forces a sort of equilibrium is maintained. The balance between them is, however, sometimes destroyed, and the parietes are no longer able to restrain the viscera within their normal limits. Thus hernia is often associated with a great increase in the bulk of the viscera, from the rapid development of fat in the omentum and mesentery. A persistent laxity of the parietal peritonæum likewise, subsequent to distension of that membrane, occasioned by the gravid uterus, is a morbid condition which renders it liable to pass readily out of the abdomen, under the influence of any pressure from within, through the weak points of the walls, and it must also be reckoned among the predisposing causes of hernia.

The immediate cause of a hernia is certainly, in some cases, to be traced to a sudden and forcible diminution in the capacity of the abdominal cavity, the result of compression or contraction of its walls; in other words, the combined actions of the abdominal muscles, coincident with strained attitudes and postures of the body during the effort of violent muscular exertion generally, give rise to the sudden development of a hernia. We cannot, perhaps, accept as truth the statement of all the ruptured men who attribute their affliction to muscular exertion; but all surgeons who have had much hospital experience will be able to call to mind cases depending upon this cause.

A large proportion of the cases of hernia are undoubtedly of gradual development. In many of these, however, violent muscular contraction doubtless plays an active part. How often we observe hernial tumours in patients afflicted with dysuria! Is not hernia very liable to occur in persons labouring under bronchitis of one form or another? And, although it must be admitted that more or less laxity and loss of restraining power in the tissues of these persons exist with regard both to the fibrous walls of the abdomen and the peritoneal ligaments of the viscera, yet this effective

agent, muscular contraction, exerts its powers with less restraint and limit, and thus presses the viscera away from their normal situation.

The *hernia* consists of a part only of any of the abdominal viscera. Such of them as are permitted, by their peritoneal attachments, to change their relative situation within the abdominal cavity with the greatest freedom, most frequently escape or protrude through its walls. Thus portions of the small intestines and omentum form the contents of the hernial sac in the majority of cases, although a part of every abdominal viscus has been occasionally found therein.

Semeiology.—The signs which denote a rupture are more or less marked according to its volume, its condition, the viscus composing it, and the thickness of the tissues by which it is covered. The patient complains of 'a weakness' in the region in which a hernia commonly occurs: and this is often the first symptom which indicates a tendency to a protrusion in the adult. The inguinal region, especially in a male adult who makes a complaint of this kind, shows a remarkable fulness at the site of the internal abdominal ring, and often along the whole track of the region of the abdominal walls termed the inguinal canal, if carefully examined. From a similar appearance, a tendency to hernia may be detected in the weakly and delicate adult female at the crural aperture. In both cases the fulness becomes much more distinct if the patient maintains the erect posture and forcibly contracts the abdominal muscles.

Next, a small swelling or 'lump' is felt at the external abdominal ring, which is not permanent, but disappears under slight pressure or on assuming the recumbent posture. It reappears when the pressure is removed or on standing erect, and it becomes more prominent when the abdominal muscles are put into strong action by coughing or some voluntary effort.

In infants and children the tumour produced by a hernia is often of considerable size when noticed for the first time; but it soon diminishes if the swelling be pressed, or the recumbent posture imposed. In youthful adults also a hernia is often developed suddenly, generally in the inguinal region or scrotum. This, happening under the influence of violent muscular exertion or forcible compression of the abdominal walls, is usually attended with more or less pain.[1]

The structure of the viscus which forms the hernia also modifies its signs and indications: thus, if the protrusion be solid, as when omentum escapes (epiplocele), the hernial swelling will be hard, resisting, and lobulated; if the protrusion be hollow, as in hernia of intestine (enterocele). the swelling will be yielding, soft, elastic; and if the contents be gaseous and fluid, it will yield a dull sound on gentle percussion, or a peculiar gurgling is heard at the time the rupture is handled.

Some swellings formed in those regions where hernial protrusions commonly occur closely resemble that disease; but as they are liable to simulate some special kind of hernia, their differential diagnosis is given in other parts of this essay.

Prognosis.—By ordinary care and precaution, a person the subject of hernia is not in great danger of those accidents affecting it which imperil life. On the contrary, however, by neglecting to employ a bandage to prevent the escape of the hernia, or by making use of an instrument which fails to effect the purpose intended—namely, the complete retention of the hernia within the abdomen—the life of the individual is perpetually in jeopardy from the liability to inflammation or strangulation of the protruded viscus.

In proportion, then, as the palliative measures directed by the surgeon are carefully employed by the patient, the prognosis in any case of reducible hernia may be regarded as favourable or the reverse.

If the hernia be a small reducible enterocele, a truss may be used, which will prevent its descent for months, or even years. If the case be one of irreducible epiplocele, complicated with the occasional descent of small intestine, the prognosis must

[1] In a manuscript lent to me by Mr. Kingdon, he shows that, out of 796 adult males, only 48 pretended to assign any cause for the protrusion; but I find that the majority of the men in whom the inguinal hernia was suddenly developed were youthful adults.

be regarded as relatively unfavourable, in consequence of the great difficulty in preventing the entrance of the bowel at the orifice of the sac, where it may become strangulated without any premonitory symptoms.

Nomenclature of herniæ.—The varieties of abdominal herniæ are named from the period of life at which the hernial sac is formed; the region in which the protrusion takes place or exists; as well as from the viscus which composes the tumour.

When named from the viscus forming the protrusion, a hernia is styled intestinal when any portion of the alimentary canal escapes. This is also termed an enterocele.

If a portion of omentum protrude, the expression omental hernia, or epiplocele, signifies its nature.

A combination of these two is called an entero-epiplocele.

The terms gastrocele, cystocele, have been applied to protrusions of the stomach or bladder from the abdomen.

The classification of hernia according to the regions in which it occurs is given in the second part of this essay.

The essential parts of a hernial tumour.—When an anatomist dissects a tumour caused by the protrusion or escape of any viscus from the cavity or region in which it is naturally contained, his observations should be especially directed to three principal objects. These are:

1. *The tissues outside the sac,* or the ordinary structures of the region in which the hernia is developed;
2. *The sac*; containing
3. *The hernia* itself, or the protruded viscera.

Under these three sections we shall describe the essential elements of a hernial tumour: first, in the condition in which they commonly exist, when the only source of trouble depends upon the mere tendency to the protrusion of the hernia; and, secondly, under those morbid conditions which affect certain parts of the sac; the contents of the sac, the real hernia; and the tissues outside the sac. Upon the judicious surgical treatment of these morbid conditions the salvation of life depends.

The inciting causes of hernia.—Protrusions of the abdominal viscera result from—

1. Wounds or lacerations of the abdominal walls;
2. The weakening or destruction of the same parts by inflammatory processes;
3. The existence at birth, and persistence afterwards, of a canal which is a prolongation of the peritonæum; and,
4. The gradual expulsion of the parietal peritoneal membrane at weak parts of the abdominal walls, forming a pouch or receptacle for portions of the viscera.

1. In this essay I am not required to describe those of the first class; such cases are mentioned under the head of Injuries of the Abdomen.

Hernia, however, occasionally occurs in the inguinal region, as the result of the application of direct violence in its vicinity, without any wound of the integuments.

2. *The weakening or destruction of the abdominal parietes* from the effects of inflammation and its results give rise to the secondary occurrence of hernia. Thus, after the healing of abscesses in those parts, it is not very uncommon to see a hernial tumour developed at the site of the primary disease. It is important, therefore, as a prophylactic measure, to support the abdominal region by means of a suitable bandage during the healing of such abscesses, and for some time after cicatrisation.

3. *Congenital patency of the vaginal process of the peritonæum.*—We must now consider that congenital condition of the peritonæum which allows a portion of the abdominal viscera to escape from its natural cavity and occupy an abnormal position in its immediate vicinity.

Towards the close of the last century, and at the commencement of this one, anatomists were very much interested in observing the changes in the situation of the testicles during the period of fœtal life. Accurate observation established the fact, that the development of the testicles commenced in the lumbar regions of the fœtus in utero, and that when those organs had reached a certain stage of perfection, they

migrated from their primary locality, and, pursuing a course towards the pelvis, they at last reached the scrotum, the final point of their destination. In this progress, termed the 'descent of the testicles,' and whilst they are within the abdomen, they are placed behind the peritonæum, and partially invested by it. A prolongation from this serous membrane accompanies them into the scrotum, and receives the name of the vaginal process of the peritonæum.

Thus wrote Wrisberg in the year 1800 : 'Testis semel in scrotum delapsus pluribus cingitur velamentis. Tria esse membranarum genera, quæ id præstant, Tunica vaginalis communis pro teste, epididymide et funiculo spermatico simul ; Tunica vaginalis propria vasorum spermaticorum ; et Tunica vaginalis similiter testi et epididymidi propria ; cuilibet in arte anatomica tironi nunc cognitum est.'[1]

A direct and uninterrupted communication exists between the cavity of the peritonæum and the interior of this sheath ; so perfect, indeed, that the more movable abdominal viscera can pass, without impediment, from the one into the other. The line of demarcation between these cavities corresponds to, or is in relation with, that arrangement of the internal abdominal fascia termed the inguinal ring : and, adherent to the posterior surface of the vaginal process, near its inferior termination, is placed the testicle.

In early fœtal life, and, in many instances, for a month or even a longer period after birth, this tubular process of the peritonæum extends into the scrotum. It lies in front of the spermatic cord and testicle ; extends from the internal inguinal ring to the lowest end of that gland ; and forms a membranous, cylindrical canal until it reaches the testis, when it expands into an elliptical cul-de-sac. Before birth, or soon after, this vaginal process of the peritonæum is divided into two portions—a superior and inferior. The sheath contracts near the head of the epididymis, its surfaces adhere firmly at that spot, and thus two cavities are formed. The inferior one is termed the tunica vaginalis propria testis ; for it is in immediate relation with a large portion of the surface of the testicle. The superior canal, termed the tunica vaginalis propria funiculi, lies in front of the spermatic cord.

When these parts are in a normal condition, the inferior cavity or vaginal covering peculiar to the testis remains throughout life as a closed serous sac, and contains a little serum. Under similar conditions the superior canal or vaginal covering peculiar to the spermatic cord is entirely obliterated. Its superior abdominal or ventral orifice is permanently closed ; and although a trace of the existence of this canal is sometimes observable in adult life, it is merely a delicate fibrous cord, the ruinæ processus vaginalis peritonei. Occasionally, although very rarely, a fine membranous canal remains throughout a long life sufficiently large to admit an ordinary-sized probe. In the account of the post-mortem examination of Sir Astley Cooper, it is stated that 'a minute serous canal, not more than a line in breadth when opened, was traced, extending from' a depression at the right internal abdominal ring 'along the spermatic cord, into the cavity of the tunica vaginalis.'[2]

Sir Astley Cooper himself writes: 'I dissected a boy, six years of age, in whom the opening of the tunica vaginalis (vaginal process of the peritonæum) was still so large that I could pass a female catheter through it down to the testis.' And further on, in the same chapter, he relates a case of 'sudden descent of a hernia into a congenital vaginal process of the peritonæum, of the nature above described, in the person of a young man whilst in the act of lifting a sugar-cask.'[3] Several instances of a similar kind have come under the observation of the author of this essay.

Of the changes which take place in the vaginal process of the peritonæum.—Several distinguished anatomists have traced the changes which occur in this serous sheath to render its obliteration perfect. Without producing a literal translation of

[1] H. A. Wrisbergii, *Commentationum Med. &c. Soc. Reg. Scient. Gœttingensi oblatarum et editarum*, vol. i. p. 179, § 5.

[2] *Guy's Hosp. Reports*, 1841, p. 232.

[3] *The Anat. and Surg. Treatment of Abdom. Hernia*, 2nd edit. chap. xvii.

the writings of Seiler, I believe it will be interesting as well as useful to the reader to quote the substance of his observations.[1]

When the testis has reached the bottom of the scrotum, the inguinal canal, along which the cord passes, is still very short, scarcely one and a half to two lines long. In the fourth and fifth month the internal inguinal ring lies almost directly behind the external. The inguinal canal is developed in the later months, and soon after birth it is always longer. The spermatic cord now consists of the blood-vessels, vas deferens, nerves, and the vaginal canal, at the termination of which lies the testis and the larger part of the epididymis.

After the testicle has reached the fundus of the scrotum, the obliteration of the vaginal canal proceeds from the inguinal rings downwards to the superior border of the testis, so that only the proper vaginal membrane of the testis remains, as a rudiment of the vaginal canal—the tunica vaginalis propria testis. The time at which the closure of its ventral orifice takes place and the obliteration of the canal is completed cannot be well defined. It is usually closed, at least on one side, and generally at the upper part, from the internal inguinal ring to the centre or middle of the spermatic cord, even before the whole vaginal canal has contracted, especially that portion which is embraced by the internal inguinal ring. The first stage of the obliteration of this canal commences with this process.

In the second stage, the walls of the vaginal sheath unite together entirely, as far as the superior end of the testis; or it first closes in the neighbourhood of the testis, so that the centre part still remains open.

The third stage is accomplished when the canal is partially or entirely closed. This portion of serous membrane is converted into a flat band, which afterwards becomes connective tissue, but which is rather closer and finer than the rest of the same tissue of the spermatic cord.

In the fourth stage, this stripe of connective tissue always becomes thinner, and at last entirely disappears; or there remains behind only a slight trace of it below, above, or in the centre.

State of the vaginal process of the peritonæum at birth.—In the majority of new-born infants some portion of the vaginal canal still remains. In 21 Seiler found 4 in which it was open on both sides; 5 in which it was open on the right side; 4 on the left; and of these 13, 5 in which the abdominal aperture continued open on either one side or the other. In 5 of the 21 infants the canal was closed above and below, but in the centre open; in 3 the inferior part was closed, but in the upper part, from the internal abdominal ring, a portion remained wide open. Likewise, in other examinations, he found the inferior part unclosed towards the middle of the spermatic cord, or even as far as the internal abdominal ring; more rarely the centre was open, and still more rarely the upper part only.

Camper found, in 53 new-born infants, 23 in which the canal was not closed on both sides; 11 in which it was open on the right side; 6 on the left.

Schreger found the following relations: in 13 new-born infants, the canal was open on both sides in 8; in 6 in its centre part between the abdominal orifice and the testis; in 2 in its whole length, in which also the abdominal orifice of the right side still remained open. In the remaining 5 it was open between the abdominal fold and the testis, but only on the right side.

Paletta states that, as a rule, the complete closure of the vaginal canal takes place from the twentieth to the thirtieth day after birth.

I have myself dissected numerous fœtuses of full age, and have been surprised to find in what a large majority of them this canal continued patulous either on one side or both sides.

With a knowledge of these anatomical facts, we can readily understand how it happens that a canal or receptacle exists at birth into which a portion of the

[1] Anton Scarpa's *Neue Abhandlungen ü. d. Schenkel- u. Mittelfleischbrüche, &c., bearbeitet mit einer Anleitung zu der Zergliederung d. Leistengegend, &c.* Kupfertafeln von B. W. Seiler, vol. ii. p. 374, &c. Leipzig, 1822.

intestines may enter. When this takes place, the hernia of infancy exists. It is a circumstance of very common occurrence to see an infant soon after birth with an enlargement of the scrotum, which varies in size, and sometimes disappears altogether. It attains its largest dimensions when the infant exerts its abdominal muscles; it slowly decreases and is lost sight of during repose, the recumbent posture, or in sleep. This tumour of the scrotum is due to a hernia of small intestine which escapes from the abdominal cavity into the prolongation from the great serous peritoneal membrane, known by the name of the vaginal process of the peritonæum. This serous sheath, which, from its structure, allows of considerable distension, is thus converted into a hernial sac. The attention of pathologists was first drawn to this fact by Haller in 1749. His observations were confirmed, and the nature of the disease was still further elucidated, by John Hunter and Percival Pott. Haller employed the term hernia congenita to express that variety in which the intestine and the testis touch each other, or are contained in the same sac; and by this name the disease has been distinguished since the date of his publication. It is, however, a most inappropriate term, inasmuch as the hernia does not exist either during intra-uterine life or at birth. A congenital imperfection, it is true, allows the descent of a hernia soon after birth; and therefore M. Malgaigne calls it the 'hernia of infancy.' But even this term is not sufficiently definite. I prefer the designation, hernia into the vaginal process of the peritonæum.

4. *Of the slow and gradual development of the hernial sac.*—The peritoneal membrane is capable of very great but gradual extension. This capacity is illustrated by cases of serous dropsies and of ovarian growths. In the same manner as the whole membrane yields to the general pressure of accumulating fluid, so it dilates under the influence of local pressure into a diverticulum, or sac, until it is sufficiently capacious to contain a very large part of the alimentary canal. This condition we see in those cases of enormous double scrotal hernia, which reach sometimes even below the knees.

Every hernial sac is composed of a body, or central part, above which is the neck, and below the fundus. The mouth, orifice, abdominal or ventral aperture (*le collet* of the French), is the point of immediate communication with the cavity of the peritonæum. To the tissues forming the margins or boundaries of this opening particular attention must be directed. These constitute, by their rigidity and unyielding texture, the principal impediment to the reduction of the hernia, in most cases; and it is, therefore, this part of the sac which requires to be cut in order to replace the protruded viscus within the abdominal cavity, when the reduction cannot be effected without opening the peritoneal sac.

The development of the hernial sac.—The evolution of the slowly-formed hernial sac has been very completely traced and described by Drs. Jules Cloquet[1] and Demeaux.[2] I shall here quote as briefly as possible the chief facts related by the last-named pathologist.

When the peritonæum, depressed by the pressure of the abdominal viscera, traverses the walls of the abdomen, it presents, at first, the shape of a digital depression; then, of a funnel; and next, that of a finger of a glove. These forms are, however, somewhat dependent upon the region in which the hernia is developed. During this period the entrance to the hernial sac is larger than the fundus, and in these conditions a strangulation of the herniated viscus cannot take place. But when the fundus of the sac has reached those tissues which offer less resistance, it dilates, becomes rounded, and assumes a spherical shape; in this condition the entrance is more contracted than the fundus, and under these conditions strangulation may occur.

There are three periods or states in which the orifice and neck of the sac

[1] *Recherches anatomiques sur les Hernies de l'Abdomen*, 4to, Paris, 1817; and *Recherches sur les Causes et l'Anatomie des Hernies abdominales*, 4to, Paris, 1819.

[2] *Recherches sur l'Evolution du Sac herniaire*, &c. 8vo, Paris, 1842.

should be examined: 1st, of their formation; 2nd, of their organisation; and 3rd, of their contraction.

The first period of formation. It is important to describe the mode of formation of the mouth of the sac, since, from certain facts, conclusions which are useful in practice may be deduced. In the formation of the hernial sac it is demonstrable that the displacement of the peritonæum is a condition of more import than the stretching of the membrane.

When the hernial sac is complete, the portion of peritonæum employed to form it may be represented by a plain membrane about three inches in diameter and ten in circumference; whilst the centre of this surface is placed at the fundus of the sac at the most dilated part, the periphery, folded and puckered like the mouth of a closed purse, would be placed on a level with the opening at the narrowest part; that is to say, at the orifice of the sac, supported by the ring or the canal which the hernia has traversed. This puckering has been described by all authors, and in the plates of Jules Cloquet and Langenbeck the fact is delineated. It is also attested by preparations in almost all pathological museums. During this first period, the orifice and neck of the sac exist only in a condition to be preserved by a fibrous or muscular ring, which prevents the dilatation of the peritonæum; if this is returned into the abdomen by any mechanical means, the puckering disappears, and the orifice of the sac is effaced. If the fibrous ring is cut, or widely dilated, the same phenomenon takes place. The solution of the problem of strangulation of the intestine by the muscular or fibrous rings rests upon the study of this stage of the disease; for, at a more advanced stage, the orifice of the sac itself acquires an organisation which sufficiently explains all the phenomena of which it is the focus.

The second period, that of organisation. We may now examine the series of phenomena which take place in the neck and orifice of a perfectly-formed hernial sac. In the first period, the puckering only exists in such a condition as to be preserved by a ring, but, at a more advanced period, the different peritoneal folds form adhesions together, in consequence of the prolonged contact of their serous surfaces, and then the mouth or orifice of the sac exists independently of other structures; it becomes a new organ, annexed to the peritonæum, and has no longer need of being supported by the ring in order to exist. From this moment the orifice has an evolution peculiar to itself; it becomes the seat of very remarkable phenomena, which may be observed at different periods, and which may now be explained.

The serous surface is not alone the seat of morbid action relating to the organisation of the orifice. In the sub-serous connective tissue changes of no less interest take place. The adipose tissue in this part diminishes, and even disappears, although the person be very fat. The connective and adipose tissues seem to be transformed into a new covering, which encloses a large quantity of blood-vessels. This rich vascularisation is often seen through the transparent peritonæum of the periphery of the herniary opening, converging from all parts towards the orifice, and afterwards radiating on the superior part of the sac, where it is insensibly lost by blending with the connective tissue.

M. Demeaux considers that the organisation of this annular induration begins in the sub-peritoneal connective tissue, and that at a certain time the peritonæum itself undergoes a change; it becomes vascular, and the two structures united together adhere closely. This induration of the internal surface of the orifice of old hernial sacs is due to an annular thickening of the peritonæum, nearly limited to the boundaries of the mouth of the sac, which is thus reduced to much less dimensions than any other part of it. Preparations demonstrating these conditions, with the exception of the vascularity, are preserved in the Museums of the Royal College of Surgeons and of the different hospitals of London.

A layer of fibres, which interlace in every direction and resemble the tissue of the dartos, is said to exist around the orifice of the sac. If these be contractile fibres, they must exert considerable influence to prevent the reduction of hernia, and may be considered as *one* impediment to that result. Are they not, probably, an excess

of development of the contractile fibres of the connective tissue? M. Desprez considers them to be an exaggeration of the normal state. This dartos-like layer, having contractile properties, may also play its part in producing strangulation of some varieties of hernia.

The third period is one of contraction. Most writers on hernia have remarked the constant tendency which the orifice of the sac has to contract, and even to become obliterated, as soon as the herniated organs cease to act upon it.

This process is demonstrated in the cases of adhesion of the embouchure of the sac in infants; closure of its orifice in adults; and obliteration of the sac by persistence of omentum in its cavity. This termination, the most desirable of all, does not constantly occur. A gradual contraction may take place without the obliteration being complete: it is this disposition especially which gives rise to such formidable accidents.

At this period, if the orifice be examined anatomically, it is easy to prove that it has been the seat of a new transformation. In proportion as the tissues around the orifice becomes thicker and contract, their vascularity diminishes; and this layer, originally resembling the dartos, shows the firmness and resistance of fibrous tissue. In the second period, the orifice, susceptible perhaps of contracting spasmodically, may also permit of slight dilatation. In the third, all dilatation becomes impossible; either the margins of the orifice resist the pressure of the viscera, or the viscus which passes through the orifice becomes strangulated.

The tissues composing this annular contraction of the mouth of the sac often become nearly as hard as cartilage; and this change especially occurs in old cases, when the hernia has not been allowed to descend for a long time; for then the boundaries of the orifice are placed in the most favourable position for the process of contraction and induration to take place. But when the hernia is not reduced, the constant pressure of the viscera dilates the mouth of the sac as well as the fibrous rings.

Of the two kinds of hernial sac.—The 'hernial sac' is always a prolongation of the parietal peritonæum from the abdominal cavity into the neighbouring structures. Its development and formation, however, depend upon very opposite causes. Two kinds require to be described; the intrinsic and essential distinction between them depending upon their mode of development.

1. That kind which, being congenital, is merely a serous canal or sheath, the vaginal process of the peritonæum, until a hernia takes place and escapes into it, when it becomes converted into a hernial sac. The physiological designation for it would be THE CONGENITAL HERNIAL SAC.

2. That kind which is the result of a slow and gradual process of relaxation, and is produced by a stretching, yielding, or elongation of the parietal peritonæum, before and under the pressure of the viscus itself, which constitutes the hernia. For the sake of brevity, this kind may be termed THE ACQUIRED HERNIAL SAC.

The first kind, or congenital serous canal, which may become converted into the congenital hernial sac, sometimes exists throughout life simply as a diverticulum of the peritonæum, and without a hernia entering it; but the second kind, the acquired hernial sac, cannot exist unless a viscus, almost entirely invested by peritonæum, pushes the parietal layer of that membrane before it.

In other words, the first kind of sac is peculiar to a person born with any portion of the vaginal process of the peritonæum open, and who then possesses a receptacle for the ready irruption of a hernia; and if the ventral orifice and cavity of this sheath should not become obliterated soon after birth, a rupture may occur at any subsequent period of life; but the second kind, being an acquired formation, some length of time is necessary for its production, and it cannot exist at all without the continued and effective influence of the hernia itself.

Pott, writing of the two varieties of oblique inguinal hernia, the congenital and ordinary, expresses his belief 'that common ruptures, or those in a common sac, are generally gradually formed,—that is, they are first inguinal, and by degrees become

scrotal; but the congenital are seldom, if ever, remembered by the patient to have been in the groin only.'[1]

The paramount importance of a due appreciation of the physiological differences between the one kind of hernial sac and the other will be demonstrated in many points of view, but especially with regard to the surgical treatment of hernia.

The treatment of reducible hernia.—The surgical treatment of all kinds of reducible abdominal hernia is divisible into two categories:

1. The employment of palliative or prophylactic measures.
2. The adoption of some proceeding designed to effect a permanent cure.

1. *Palliative measures.*—To this class belong all contrivances which prevent the descent of the hernia. These are the recumbent posture, bandages and trusses of various descriptions. If we only judge from the class of cases observed in the hospitals, and selected from among the labouring population, we should form a very inadequate estimate of the advantage which accrues to sufferers with hernia by the employment of well-adjusted trusses. We know of adult persons in comfortable circumstances who, having no need for toil, have taken precautionary measures to prevent the recurrence of the rupture, and have consequently been free from everything of the kind for several years after. Some have even been enabled to dispense with the use of the truss entirely, after wearing it some months. It is, however, a condition of the utmost practical importance that the case be treated immediately that the disposition to the formation of rupture is detected. When the hernia enters the vaginal process of the peritonæum, and that sheath is converted into the hernial sac, we may effect a cure by attempting to call forth the processes adopted by nature to close its orifice and obliterate that canal; or, in other words, to procure adhesions of the serous surfaces of this peritoneal diverticulum.

On the other hand, in the slowly-forming hernial sac, the object in making use of a truss should be, in the first instance, to prevent the development of the peritoneal sac. This may be accomplished by applying support to those weak parts of the abdominal walls through which the parietal peritonæum is forced. When, however, the sac is once developed—and this is commonly the period at which a surgeon is consulted—measures should be immediately adopted to assist in arresting its dilatation by preventing the descent of the rupture.

The expediency of judiciously pursuing the mechanical treatment of every variety of hernia cannot be too strongly urged upon the laity by the profession. In both sexes it should be carefully conducted the moment that the slightest protrusion shows itself. Whether the hernia occur in infancy, youth, at middle age, or at later periods of life, if properly watched and judiciously supported, it usually gives but little trouble; in many cases it is even cured. But, on the contrary, if it be neglected, increase in bulk, and, sooner or later, diseased states of the rupture, often leading to the death of the individual, will almost infallibly occur.

The only exception to be made to this rule applies to those rare cases of hernia into the vaginal process of the peritonæum in which the abnormal situation of the testis interposes a practical difficulty to wearing a truss, the necessary pressure of which occasions intolerable pain by compressing that organ simultaneously. But even such cases should not be abandoned as hopeless of cure, without a reasonable attempt being first made to afford relief.

The practice of leaving cases of rupture in the hands of mere tradesmen cannot be too strongly censured. Among the poor, we constantly observe the lamentable effects of this proceeding. Ill-shaped trusses are applied; the springs being too feeble, allow the hernia to descend behind the pad, where it becomes compressed; or they are too strong, and their pressure induces absorption of the abdominal parietes, on which the pad presses. Frequently a truss suitable for supporting a femoral hernia is applied to one of the inguinal kind, and *vice versâ*. That which is worth

[1] *The Chirurgical Works of P. Pott*, edit. 1808, vol. ii. p. 120.

doing at all is always worth doing well. This injunction receives strong confirmatory testimony in the treatment of ruptures by mechanical means.

Characteristics of trusses.—The requisite and essential qualities of a truss are lightness, firmness, elasticity, so that it shall retain the required form or shape, suitable adaptation to the configuration of the wearer, and sufficient strength of spring to prevent the escape of the rupture from the abdomen.

The instrument consists of a pad or cushion attached to a metallic spring, with straps, so arranged that its movement during the varied postures of the body may be restrained.

Through the kindness of Mr. J. A. Kingdon, Surgeon to the City of London Truss Society, we are enabled to give the results of his extensive experience in the employment of trusses.

He considers that the circular spring truss is the most suitable form, in the majority of cases. Bandages which are not elastic do not afford sufficient support to the hernia in every posture of the body. They are necessarily unsafe on this account, as they become lax in the stooping posture of the wearer—the position of all others in which the hernia most easily descends, because of the relaxation of the pillars of the external ring. The curve of the spring and the relative position of the pad with it should be appropriate to the configuration of the wearer. A single piece of metal should form the spring and foundation of the pad. As far as practicable, the spring of the truss should pass around the bony rim of the pelvis, fitting closely to the figure, and should lie out of the region of the glutæi muscles. For, unless it be so placed, their alternate action in progression produces a corresponding movement of the pad. If these muscles be largely developed, extending upwards to the very edge of the pelvis, the curve of the spring should be wide at the shoulder, so that its bearing or resting part may be on the base of the sacrum.

For a single pad truss the free end of the metal spring should be beaten out flat and thin, and so shaped as to cling around the opposite hip—an arrangement which materially aids in steadying the truss.

The form of the spring may be designated as after the French model or the German. The former resembles the coil of a watch-spring, and is very elastic and clinging; the latter almost exactly fits the outline of the body in its state of repose. It is almost inelastic, and very hard. The French is always pressing inwards, even when the wearer is at rest. The German scarcely presses at all when the abdomen is soft, but resists with power when any expulsive force makes the abdomen swell. In practice, the best shape for the spring is one which forms a medium between these two extremes.

The pad or cushion should be of moderate dimensions. For the adult, it should not exceed two and a half inches in length, and two inches at the widest part. Its superior edge should follow the upper line of the spring, which falls a little from the shoulder or bend, where it lies in contact with the hip. The inner surface should be directed slightly upwards, but this inclination must depend upon the prominence, or otherwise, of the abdomen, as well as, in some measure, on the anatomical relations of the pelvis to the spine. The proper shape for the cushion or pad, and the materials of which it should be constructed, may be varied to accommodate particular cases, or to accord with the views of different inventors. Generally, the wearer discovers, after a little experience, which kind of pad is most free from annoyance. That pad, however, is the best which maintains perfect and unintermitting retention of the hernia. Every pad should have attached to it two studs—one near its junction with the spring, and another at its lowest point. To the upper one the transverse strap passing from the free end of the spring is attached. The lower stud is used with the thigh-strap, which should be always worn. It is loosely fastened on to the spring of the truss near its shoulder, and should fall along the hollow beneath the buttock. In the erect posture of the wearer this strap should be moderately tight. It prevents the pad from shifting from its proper position, and should never be discarded.

These appear to be the general principles by which a surgeon is to be guided in

the selection of a truss. Particular modifications suitable for special kinds of hernia will be noticed in other places.

Of the so-called radical cure of a hernia.—It would be idle to encroach upon the limits of this essay by describing in detail every method employed to effect a cure of hernia, from the most remote periods. A mere notice of them will suffice. They were—castration ; cauterisation of the orifice and neck of the sac ; ligature applied around the neck of the sac ; incision of the sac, and subsequent healing of the wound by granulation ; excision, suture, and scarification of the sac ; detaching the sac from its connections and returning it into the abdomen ; immediate and forcible compression of the sac by a bandage or truss ; cold douche ; stimulating injections, especially tincture of iodine. Such proceedings have been long abandoned, in consequence of the fatal results which frequently attended their employment.

We must, however, add the treatment recently adopted—namely, invagination of the hernial sac. Every modification of this operation is usually designated by the name of the inventor : thus there is the method of Gerdy, of Wutzer, of Rothmund, and others.[1]

The principle of this operation is expressed by the words 'invagination of the hernial sac.' That is to say, the fundus of the sac is pushed up into its mouth, and retained there until adhesions have formed between it and the entire circumference of the orifice. By this means it is hoped that obliteration of the ventral orifice of the sac and of its cavity may become permanently established. It is an indisputable fact, that cases of reducible inguinal hernia have been permanently cured by the performance of an operation on the plan of Wutzer. We have not, however, the data by which to establish the proportion of cures to failures ; but that a considerable number of the cases operated upon did fail, is certain.

Mr. Kingdon has very kindly given me the notes of sixteen cases in which an operation for the radical cure of the rupture has been performed, either by London, provincial, or colonial surgeons. The patients applied to him for relief at the City of London Truss Society. In most of these persons, at the time they ceased to be under the observation of the operator, the rupture was 'cured ;' for reports of some of the cases appear in the medical periodicals of the day. In some of these patients the rupture was larger than before the operation, and greater difficulty was experienced in retaining it within the abdomen. In others, a protrusion existed on both sides, the second having become developed after the operation.

Through the intervention of Dr. Hermann Weber, Physician to the German Hospital, I have received a valuable communication from Dr. Otto Weber, of Bonn, who was formerly clinical assistant to Professor Wutzer. The number of persons upon whom the Professor operated amounts to about fourteen. Between 1852 and 1856 the operation was performed but once in the 'Klinik,' during which time Dr. Otto Weber was clinical assistant to Wutzer. The patient was a teacher, forty years old. He quitted the hospital 'cured,' but the hernia returned in spite of his having worn a truss.

Wutzer is still of opinion—1. That when the operation is properly performed after his method, it is not attended with danger. 2. That he has succeeded in fixing the plug of skin with invagination of the hernial sac by inducing adhesions between its internal surface and the interior of its neck. 3. That in consequence of this, if the patient continues to wear a truss (for life), a return of the hernia may be avoided.

However, Dr. O. Weber writes that he has never seen any of the so-called 'cured cases' radically cured, but that—First, the plug of skin is, by degrees, entirely drawn out again ; secondly, that the true herniary apertures, the external and internal rings, are not closed by the operation ; and, thirdly, that an imperfect cure may be effected by means of a partial closure, by adhesion of the internal walls of the neck of the hernial sac, and thickening of the surrounding connective tissue.

[1] The most complete account, especially of the German cases, is to be found in Günther. *Lehre von den blutigen Operationen*, Lieferung 50.

The cases which Dr. O. Weber had an opportunity of examining some time after the operation, showed a slight protrusion of the intestine into the inguinal canal; and there would have been a perfect return of the hernia if trusses had not been worn. It appears that, at first, the invaginated skin becomes adherent to the inguinal canal, but without the participation of the hernial sac; that the latter probably becomes merely compressed by the invaginated skin passing by its side. In the most favourable cases the inner walls of the hernial sac may adhere together, but so loosely that they soon become separated by pressure.

The results of the examination of the bodies of persons after death, upon whom the operation had been performed, are very important. Streubel has published some. Dr. O. Weber examined the body of a man who died of pneumonia in 1856, and upon whom Wutzer operated in 1840. The hernia had returned after the operation. There was not a trace of the invaginated skin in the inguinal canal, and the peritonæum did not show any signs of previous inflammation. The hernia and its sac did not differ from the ordinary cases of the same kind.

Dr. O. Weber thinks that Wutzer's method might be perhaps modified in such a manner as to become effective. But, first, he considers it is necessary to show upon the dead body that the fundus of the hernial sac can be actually invaginated into its orifice, and not merely pushed up a certain distance before the integuments.

But, instead of describing in detail the operation of Wutzer and its modifications,[1] let us inquire, what is the object the surgeon has in contemplation when proposing to perform an operation for the radical cure of a hernia? In order to be effectual and permanent, it must, of course, produce the obliteration of the hernial sac; the closure of its ventral orifice; the strengthening of those weak parts in the walls of the abdomen through which the rupture protrudes; and to these conditions must be also added, an improved tone of the peritoneal ligaments of the viscera, by which the power they exert in retaining the viscera in their normal situation is restored. Unless the operation perfectly and completely accomplishes these ends, failure must most certainly ensue sooner or later.

Another intention which the successful issue of the operation is expected to fulfil, is to enable the sufferer to dispense with the use of a truss, and thus to be free from an intolerable incumbrance. To recommend a dangerous operation, therefore, which may prove only so far successful as to impede the descent of a hernia, but yet leaves the patient under the necessity of continuing to wear a truss to prevent a recurrence of the rupture, is surely scarcely justifiable. It is contended by the advocates for the operation that the dangers to which the patient is subjected have been too prominently set forth. This may be true. Few persons have, indeed, died from peritonitis, or other causes, in proportion to the numbers upon whom the operation has been performed. But they all were subjected to that risk, and because they happily escaped the fatal complication, that is no ground for the inference that others would do so also. The facts only show that the operation may be done without exciting peritonitis in every case.

The surgeon, in the attempt to carry out his object, proposes to produce an effect in imitation of the processes of nature during the early periods of life; for there are facts to demonstrate that the cavity of the vaginal process of the peritonæum, which is, in so many cases, an apt receptacle for any protruded viscus, may become obliterated even after a hernia has passed into it in early infancy. But where is the evidence to prove that an acquired hernial sac becomes thus obliterated by similar natural efforts? The only instances, perhaps, are those in which the orifice of the sac is plugged by adherent omentum; and such cases are very rare.

We therefore believe that we shall not err in enunciating the principle that the cases of inguinal hernia selected for the performance of all operations for the radical cure should be those in which the protruded viscus has descended into a patent vaginal process of the peritonæum, and that all other kinds should be rejected as

[1] Operations intended to effect the radical cure will be described with the treatment of the special kinds of hernia.

unsuitable; and that the more efficiently the proposed methods accomplish the ends effected by the processes of nature, the more worthy of confidence they become. Thus, allowing nature to guide our procedure, we must make it a rule to select those cases in which her efforts have failed; and, by acting as her handmaid, we may reasonably hope to arrive at a successful result.

We may conclude these observations with the following quotation from the work of Mr. Lawrence: 'The subject of an incarcerated rupture submits to an operation in order to save his life. But he whose hernia is reducible, endangers his life to get rid of an inconvenience; and the operation affords no greater prospect of entire recovery than he had without it. For after he has undergone an operation, at the hazard of life, the complaint may return; and the only protection against relapse is to wear a truss.' [1]

The morbid conditions of the hernia, and impediments to its reduction.—A hernia is said to be reducible when the protruded viscera can be returned into the abdominal cavity; it is irreducible when they cannot.

The impediments to the reduction of a hernia may be classed in three groups: those produced by the tissues outside the sac; those occasioned by the sac itself; and those which exist within the sac.

There are also primary or immediate causes which render a hernia irreducible, as well as secondary. Among the first we may include all those impediments to reduction which depend upon organic conditions, and relate directly to the hernial sac; as, the muscular contraction which influences the size of the abdominal rings and the tension of the tissues around the orifice of the sac; the condition of the orifice of the sac itself; and the development within the sac of adhesions or omental sacs.

The secondary are those which are partly exclusive of the hernial tumour, and occur, as it were, accidentally, and are merely due to individual peculiarities; as, for example, the development of a thick layer of fat around the hernial tumour; its great mobility; its diminutiveness; tension of the sac from accumulation of the fluid or gaseous contents of the bowel; adherent omentum lying in front of the intestine; and some other conditions.

The morbid conditions of the hernia which give rise to more or less serious difficulties may be classed under one of the following states: 1. Permanent irreducibility. 2. Distension or inflation by fluid, gaseous, or solid contents, termed obstruction. 3. Inflammation. 4. Strangulation.

1. A hernia becomes permanently irreducible, after many years' existence, on account of its size. In most cases this condition is only attributable to neglect of the use of a truss. The largest double rupture I have seen was in a bricklayer, fifty-five years old, whose bodily health, strength, and conformation were in other respects very good. The left hernial tumour was the larger, although it had only existed about three years, whilst the right had been there twelve. The lowest border of the tumour very nearly reached to a level with the patellæ. Its circumference in the largest part measured thirty inches.

Adhesions, also, when formed between the contents of the sac, or between the sac and its contents, prevent the reduction of the protrusion.

2. Distension; choking; obstruction; rendering the hernia irreducible. This particular state or condition of a hernia is attributed to the accumulation of the solid, fluid, or gaseous contents of the alimentary canal within that portion of the bowel which constitutes the protrusion. From this cause the passage of the stercoraceous contents of the canal are arrested; the alimentary canal or tube becomes choked up with its own secretions and the egesta of the stomach, giving rise to local troubles and constitutional disturbance.

The doctrine of obstruction is of great antiquity, and for a long period that morbid condition of a hernia we now term 'strangulation' was believed to originate in this

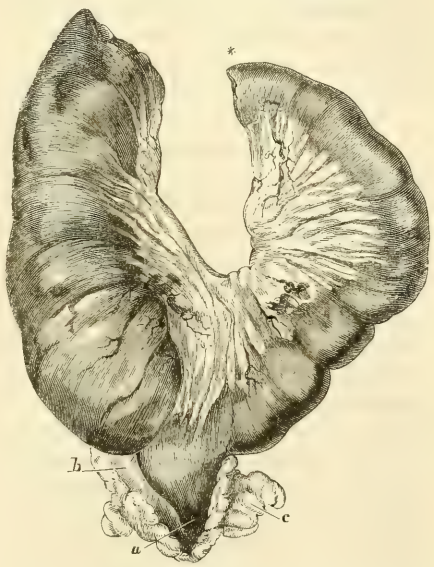
[1] *Treatise on Ruptures*, chap. vi.

cause alone. 'During nineteen centuries,' writes M. Broca, 'the existence of an accumulation of fæcal matter in the hernia had been admitted, or rather supposed; but when it was looked for, the accumulation was not to be found. Thus theory fell to the ground on the first observation.'

The local symptoms of an obstructed hernia are—pain, a flatulent state of the tumour, increase of size in comparison with its usual dimensions, more or less tension, and the absence of those more severe local conditions which characterise a strangulated bowel. By careful manipulation, the gaseous and fluid contents of an enterocele may be expressed into the contiguous part of the canal, and even solid fæcal matter may be felt. During this proceeding the gurgling produced by the flatus and fluid is heard, and the movement of these is sometimes felt as they escape through that portion of the bowel lying within the orifice of the sac.

At first, the constitutional symptoms indicate functional disturbance of the alimentary canal, rather than any morbid state of the tissues of the herniated viscus. There are indications merely of a blocking-up of the tube, and nothing more. Thus, slight pyrexia and nausea, succeeded by vomiting, are the most marked features, which continue even although the large intestine below that portion in the sac has been emptied of its contents after the commencement of the attack. Unless the vomiting be very prolonged, and great depression result therefrom, as occasionally happens in very delicate or old persons, the surgeon will not fail to remark the absence of the urgent symptoms characteristic of strangulated bowel.

FIG. 159.—Hernia at the Femoral Ring of a part only of the Walls of the Bowel.



The patient, 56 years old, had been ill nine days, when the exploration of a small swelling in the site of the left femoral ring was made. She was then dying, but survived the operation forty-five hours. After death peritonitis was found, and the intestines in the pelvis were united together. * The cæcal end of the bowel, the tube contracted between it and the hernia adherent to the sac; *a*, intestine adherent to the sac; *b*, peritoneal sac; *c*, lobules of fat outside the peritoneal sac. (Museum Guy's Hospital, Drawing 484²⁰, Preparation 2503²⁰.)

In most cases of obstruction the impediment is removed by those means which excite the natural peristaltic movements of the alimentary tube. The local application of warmth and moisture to allay pain; repose; the administration of aperient enemata, or even in some cases, when vomiting has not occurred, of purgatives, by the mouth, are beneficial. Abstaining, in the first instance, from manipulation of the tumour, is a point of great importance. Should the impediment to the passage of the indurated fæcal matter depend upon the contraction of the orifice of the sac, the enlargement of this part becomes necessary, either by cutting its tissues or those around it. The operation must then be performed in the usual manner, and in relation to the special case.

3. *Inflammation of a hernia.*—A hernia in this state shows all the local signs, and excites the constitutional symptoms, of inflammation. The combinations of those indications which characterise the condition called strangulation do not, however, exist.

Inflammation is usually the result of external violence, and may be produced by the pressure of badly-fitting trusses. A morbid state of the whole alimentary canal, of an inflammatory type, may extend to the hernia, and in that way give rise to local trouble.

Irreducible epiploceles are more liable to be inflamed than other kinds of hernia; and a patient the subject of reducible epiplocele may have the hernia inflamed,

from which cause it becomes permanently irreducible by contracting adhesions to the sac.

The local signs are—pain, increase in the bulk of the tumour, a certain degree of hardness, firmness, and elasticity when it is pressed, with more or less unevenness and irregularity of surface. The margins of the aperture through which the hernia passes do not tightly embrace the protrusion, so that, in a large hernia, the finger can be passed along the pedicle of the tumour for some distance.

The constitutional symptoms are not usually severe. In the first stages more or less pyrexia arises; and when the contents of the tube are arrested in their course, the indications of that condition become marked.

It is unnecessary to describe in detail the local and constitutional measures to be adopted. Reliance must be placed upon those in ordinary use to control and arrest the disease.

There occasionally happens a variety of hernia, first noticed by M. de Littre,[1] in which only a portion of the wall of the ileum, or a diverticulum from the bowel, becomes adherent to a very small hernial sac. By extension of inflammation to the neighbouring viscera, obstruction to the passage of the stercoraceous contents of the tube arises, and death ensues.

Fig. 159 illustrates this variety. It was drawn from a case which was under the care of the writer.

4. *Strangulation.*—A hernia is said to be strangulated when the displaced viscus is subjected to a constriction which impedes or arrests the circulation of the blood through its vessels, the passage of the stercoraceous materials along its canal, and constitutes an impediment to its return into the abdominal cavity. This condition excites constitutional symptoms of a most dangerous and characteristic nature.

Is the condition of a hernia, termed strangulation, solely the result of mechanical constriction produced by the margins of the orifice of the sac; or does it depend upon a morbid action engendered in the tissues of the protruded bowel antecedent to its escape from the abdominal cavity? In several instances of strangulated femoral hernia in women, and some cases of inguinal hernia in men, the patients themselves voluntarily stated that, for some hours before the hernia caused any inconvenience, or was even in the sac, their bowels had been 'disordered,' 'relaxed,' or that they had been suffering with 'bowel-complaint.' In other cases, there seemed to be a great tendency to a very rapid derangement of the mucous membrane along the whole track of the canal above the hernia, scarcely explicable upon the supposition that it had been all excited by the mere existence of a constriction around a small knuckle of intestine. As evidence of this morbid action, I would adduce the fact of the rapid and abundant secretion from the entire mucous surface of the small intestines, their great distension and intense vascular congestion, witnessed in some instances.

Again, given any case of reducible hernia, which for months, or even years, has readily glided into the hernial sac, and has been returned as easily into the abdominal cavity, why on some particular occasion should it become irreducible when it has passed through the same orifice it has been in the habit of traversing, and in the tissues of which no appreciable changes have occurred? For it is in vain we seek any marked alteration in the structures around or composing the orifice of the hernial sac itself.

In giving an affirmative reply to the above inquiry, we are justified by facts in attributing the strangulated state of a hernia to a predisposing cause, commencing in a morbid state of the alimentary canal generally; at least in some cases. Patients often relate how they had observed that the hernial tumour was 'larger than usual' before they suffered much inconvenience; and this circumstance is commonly attributed by them to a greater bulk of the protruding viscus. But we have no proof that this is the correct explanation of the increase of the size of the tumour in all cases; in some doubtless it may be. It is due to a distended state of the bowel rather than to quantity.

[1] 'Obs. sur une nouvelle espèce de Hernie,' *Mém. de l'Acad. royale des Sciences*, 1700, p. 300.

Let us examine a case of reducible inguino-scrotal enterocele. At one moment all that the surgeon can detect is a slight fulness produced by an empty hernial sac. At another, a small knuckle of intestine, having descended in an empty condition, becomes more or less filled with the stercoraceous contents of the alimentary canal from above it, and an elastic swelling results, which is produced by the bowel and its contents, fluid and gaseous. Assisted by the peristaltic movement of the viscus itself, or by gentle pressure, these contents of the tube are conveyed along the proper channel, and the hernia—that is, the bowel—is emptied, and it readily resumes its normal position in the abdominal cavity. Observe, now, that the tissues of the bowel have undergone no change. But let the distension continue, and the first indications of mischief are local pain and an enlargement of the swelling; next, a sensation of uneasiness in the hypogastrium, of dragging from the rupture upwards, still greater increase in the magnitude of the tumour, and great pain when handling it, take place. Do we not recognise in these phenomena the peristaltic action of the canal, the swelling of the tissues of the hernia by congestion of its vessels and irritation of its nerves? During these progressive stages the protrusion has attained a size dependent upon more than one cause. Distension caused by accumulation of its contents, and swelling of its tissues, induced by the effusion of inflammatory products, reacting against the narrow orifice of the sac, produce more or less retardation or arrestation of the sanguineous current in the blood-vessels of the rupture, and its strangulation is the result. The increased bulk of the protrusion prevents its retrograde passage through the small aperture by which it escaped from the abdomen. The body of the sac being also stretched, may mechanically contract the dimensions of its orifice in some measure; whilst the arrangement of the whole tumour, in relation to the mouth of the sac, may likewise afford an impediment to its reduction.

The filaments of the nerves of the injured bowel play an important part in transmitting thence to the nervous centres the local disturbance of their sentient extremities, and constitutional sympathies are excited. The heart contracts more frequently, and with greater force; the pulse is full, and more frequent than normal; the cheeks are flushed; the surface of the body is warmer than usual, often moist, though sometimes dry; the tongue is covered with a white fur; nausea and intolerance of food are complained of; tenesmus occurs, and flatus or a small quantity of fæces may be expelled, if the large intestines chance to contain any.

Uncontrollable retching and vomiting become the next established features of the disease; prostration of the bodily powers rapidly supervenes, and death may take place at this stage from collapse alone.

Enlarging upon this brief sketch of the symptoms which indicate the commencement and progress of strangulation of intestine, we must now systematically describe—

First, the condition of the hernia when strangulated.

Secondly, the changes taking place in the tumour.

Thirdly, the constitutional symptoms excited by the local disease; and,

Fourthly, the morbid conditions developed within the abdominal cavity.

The structural changes taking place in the hernia.—When the bowel is in the condition implied by the word 'strangulation,' the circulation of the blood within the vessels of the part is, at first, impeded. Congestion of the capillary vessels is the consequence, and the tissues of the viscus become swollen. When exposed to view, in this first stage, the serous membrane is of a deep-red tint, and through a lens the minute blood-vessels may be distinctly seen with their outlines well defined. To the touch the hernia feels firm, and resists slight pressure; but the elasticity and resiliency of its tissues still continue unimpaired.

Next, the circulation of the blood is arrested. The tissues of the bowel, about which the constriction is tight, become now more swollen; they have palpably a solid, leathery consistence; the colour of the serous surface is a dark purple; it is dull, lacks its usual lustre, and sometimes, varying as regards shade or depth of colour, it is mottled with a red and purple tint. Patches of extravasated blood appear in

the subserous connective tissue, and an adhesiveness to the fingers is very striking.

When the bowel has been strangulated many hours, its tissues are more swollen and soft; they no longer possess their characteristic elasticity, but they remain in the same position in which the pressure of the finger places them. The serous surface has lost all its characteristics; it is black, ash-coloured, flocculent, and adhesive. In this stage all the tissues of the bowel have undergone more or less disorganisation; blood is extravasated in the connective tissues between the different coats of the viscus; the mucous membrane is soft, flocculent, and easily detached from the fibrous walls. Probably in some part of the bowel, at its convexity, or where it is in immediate relation with the mouth of the sac, its tissues have sloughed, or ulceration is concealed by shreds or patches of adherent lymph. The intestine is also firmly fixed to the mouth of the sac by inflammatory adhesions.

The last stage is that in which the entire mass of the protruding bowel has become gangrenous, or has passed into a condition termed sphacelus.

In the diseased conditions just described, we may recognise morbid changes similar to those which are observed in structures on the outside of the body. If a string be tied around the penis near the prepuce, the latter organ becomes first swollen; secondly, inflamed; thirdly, it suppurates; and lastly, it mortifies. Ulceration also takes place at the part with which the ligature is in contact.

The coats of the bowel are often ulcerated by the pressure of the constriction to which they are subjected, but the various tissues of which the viscus is composed are endowed with different powers of resistance to those morbid processes. Thus it may be seen, on cutting open the intestine, in cases in which the bowel has been deeply sulcated or grooved on its serous surface, without any trace of abrasion thereon, that the mucous membrane is ulcerated in a line corresponding to the part immediately embraced by the medium of constriction. Occasionally it happens that the line of ulceration forms only at that end of the strangulated bowel directly continuous with the upper and distended portion of the alimentary tube, whilst there is none at the other end. This is probably caused by the pressure of the distended bowel within the abdomen, and it may be seen, particularly in some cases where the knuckle of intestine lies in close relation with Gimbernat's ligament. We have even observed blood in the fæcal evacuations of patients who have died with the bowel thus diseased.

Mr. Bryant states [1] that ulceration at the line of stricture is most frequently in inguinal hernia, although the sulcated condition of the bowel is as common in femoral as in inguinal; and that fæcal extravasation, if not produced by ruptured bowel from taxis, generally follows ulceration at the line of stricture.

Small, recently-developed herniæ are more frequently strangulated than large ones, and those which have existed some time. Sir A. Cooper writes: 'A small hernia is more easily strangulated than a large one, the pressure on the contents being more violent, and the symptoms are much more urgent, as the stricture acts with much more effect upon a single knuckle in stopping its circulation, than when the contents of a hernia are large and voluminous.' [2]

It is a matter of great importance to distinguish between the two classes of hernia —'RECENT' and 'OLD.' Mr. Pott observes: 'Recent hernias are in general more liable to stricture than old ones, for reasons which are obvious from what has already been said; but when old ones get into the same circumstances, the symptoms are much the same; though I think in general they are not altogether so pressing, and the latter generally admit of more time to attempt reduction in.' [3]

And Mr. Bryant has demonstrated, by the cases admitted into Guy's Hospital, that in recent hernia strangulation frequently occurs, and that the risk attending it is very great, even although the bowel be speedily liberated.[4]

[1] *Guy's Hospital Reports*, 1856.

[2] *The Anatomy and Surgical Treatment of Abdominal Hernia*, part i. chap. vii., the last paragraph.

[3] *The Chirurgical Works of P. Pott*, edit. 1808, vol. ii. p. 63.

[4] *Guy's Hospital Reports*, 1861.

Morbid states of the hernia induced by violent manual pressure.—Let it not, however, be assumed that the morbid states of a hernia, above described, are always inevitably due to the compression which the orifice of the sac has exerted around it. Such is not the fact. The tissues of the herniated viscus are rarely so firmly constricted as to produce in a short space of time complete mortification, absolute death, of the whole of the knuckle of bowel in the sac; yet this state of the hernia is often met with. In these cases, the protruded viscus has been subject to another source of damage and destruction. Under the mild expression of 'the use of the taxis,' the hernia has been forcibly compressed by manipulation; its tissues have been contused and irreparably damaged; blood has been extravasated in profusion between the different layers of the tissues composing the viscus, and complete disorganisation of its structures is the result of the injury inflicted. I have been for many years interested in ascertaining, from the observation of the state of the bowel after death, the comparative amount of injury inflicted on the viscus by the natural constriction of the orifice of the sac, with the tissues around it, and that produced by violent manipulation of the tumour, with the hope of reducing the hernia. I am constrained to state that the damage produced by the first cause is in no degree commensurate with that which results from the last; and that in all the instances in which the entire bulk of the herniated bowel was in a state of sphacelus, that condition was the result of violent, protracted, and ill-applied manipulation. The progress of these morbid processes is likewise accelerated by the same means; for it does not often happen that mortification of the whole piece of the bowel is observed in those cases in which the nature of the disorder happens not to have been recognised very early, and when the manipulation of the tumour has not been employed.

I may represent the danger which is associated with violent attempts to reduce the hernia, by stating, in a few words, that more irreparable damage may be inflicted on the bowel in a few minutes by coarse, careless, impetuous brute force, than the natural means of constriction could produce in several days.

Need I add, that in the attempts to reduce a strangulated hernia, the employment of such violence as must be necessary to produce these results is reprehensible in the extreme, and is justly condemned as not only opposed to every sense of humanity, but because it is in violation of all the principles of practical surgery?

Artificial anus.—Two conditions of the intestine lead to the formation of an artificial anus. One, in which a portion only of the wall of the intestine sloughs, leaving a small ulcerated opening as if a piece had been punched out, which does not interfere with the continuity of the alimentary canal, although it allows a portion of its contents to escape. This opening commonly forms at about the centre of the convex free border of the knuckle of intestine, and at a point farthest removed from the orifice of the sac.

Another variety is due to ulceration of all the coats of the bowel, even to the mesentery. It usually occurs in the part of intestine at the mouth of the sac; and, in consequence, the continuity of the canal is destroyed, and all the stercoraceous matter escapes through the opening.

Intermediate between these two extremes we meet with varieties in which more or less of the walls of the tube is destroyed, producing corresponding results. I may state that, after the first accident, repair of the hole frequently takes place, the wound of the integuments heals perfectly, and complete recovery ensues.

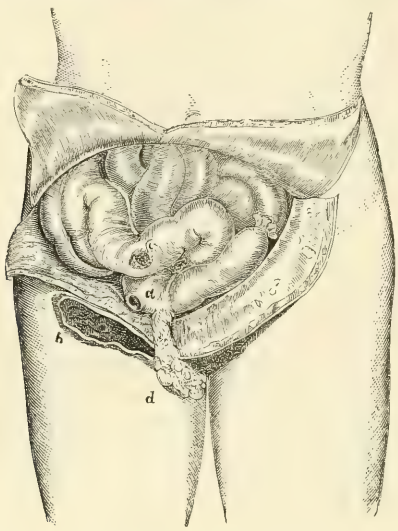
After the second, however, the prognosis is not so favourable; for, commonly, an artificial anus is permanently established, and more or less of the contents of the alimentary tube are discharged thereat.

As the result of long-continued constriction by the mouth of the sac, and the pressure made upon the two pieces of intestine lying therein, their walls become adherent at the points of contact, ulceration takes place, and the continuity of the tube is thus established within the abdomen, by the processes of nature alone. This

condition is very rarely met with, and I may therefore refer the reader to a published case.[1]

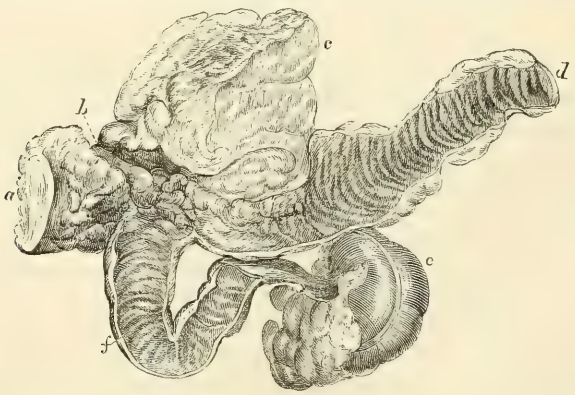
Figs. 160, 161 show the appearances before described.

Fig. 160.—Artificial Anus after Strangulated Ileum, at the convexity of the Tube.



The patient, 72 years old, was the subject of strangulated femoral hernia for 'two days,' but probably more, when the protrusion was returned by operation. The bowels acted freely by the anus, but on the fifth day from the operation fæcal matter was discharged from the wound (*b*). Fæces continued to pass through it until death, which took place seventeen days after the operation. The perforated bowel was the ileum, about a foot from the cæcum, which is seen in the woodcut (*a*). It is raised from the mouth of the femoral aperture to show it more distinctly. Fæcal extravasation into the peritoneal cavity was prevented by adhesions between the margins of the perforation, neighbouring coils of bowel and omentum (*c*, *d*). The patches or marks on the coil above and behind are the remains of those adhesions. (Drawings, Museum Guy's Hospital, 486[5].)

Fig. 161.—Illustrates that variety of Artificial Anus in which the continuity of the tube is destroyed in consequence of destruction of the entire calibre of the bowel.



From a case of femoral hernia in a woman 67 years old. The bowel had been strangulated fifty-five hours when herniotomy was performed and the intestine reduced into the abdomen. Four days afterwards fæces escaped from the wound. Sloughing took place around the wound, and the woman lived three weeks. *a*, symphysis pubis; *b*, fistula leading from the intestine *d*, the lower end of the ileum *f* ending in the cæcum *e*; *c*, part of the abdominal walls. (Drawing, Museum Guy's Hospital, No. 486[45].)

Morbid conditions of the coverings of the hernia.—The changes taking place in the tumour affect the hernial sac and its coverings or investments. When they are purely the result of disease induced by strangulation of the hernia, they extend progressively from within outwards; but if produced by violence in the manipulation of

[1] *Transactions of the Pathological Society*, vol. x. p. 128; the preparation is preserved in the Museum at Guy's Hospital, No. 2492[10].

the tumour, the integuments show early indications of the injury by ecchymosis, as well as inflammation of the subcutaneous connective tissues, œdema, &c.

The severity of the pain caused by handling the tumour when the hernia is strangulated differs in a remarkable manner in different individuals. In some persons the tumour becomes quickly sensitive, and even intensely painful, so that the patient is intolerant of the most gentle manipulation, especially in the region of the orifice and neck of the sac. Sometimes, in cases of acute strangulation especially, the sufferer can scarcely be induced to lie quiet in bed, but writhes about in torment praying for instant relief. Other patients, on the contrary, endure the necessary examination and even pressure of the tumour, without evincing very marked signs of pain.

At indefinite periods, after symptoms of strangulation of the intestine have appeared, the size of the tumour often increases rapidly; its surface becomes more uniform and regular; the integuments tense, smooth, shining, red, with increase of temperature; and the general outline of the whole swelling assumes a more pyriform shape, or is more locally circumscribed, according to the variety of the hernia. Fluctuation may also be detected in some cases. It must, however, be remembered that the displacement of gas by pressure upon the tumour causes a sensation very closely resembling that which indicates the presence of fluid, and that the difference between one and the other is not always perceptible even by surgeons of great experience in delicate manipulation.

The sudden enlargement of the tumour is explained by the fact of a rapid secretion and accumulation of serum within the hernial sac in numerous instances; by the distension of the enterocele with gases in others.

Characters of the serum in the sac.—The serum varies in character according to the duration of the strangulation. When the sac containing a strangulated hernia is cut open, some fluid usually escapes. In colour, consistence, and odour, this serum varies considerably in different cases; and these diversities may be regarded as important indications of the condition of the tissues of the strangulated bowel.

It is pale yellow, clear and bright, when strangulation has existed a few hours only; and, under these circumstances, the intestine is simply deep red from vascular congestion, and its tissues elastic.

It is dark brown, but clear, when strangulation has existed many hours; and the intestine is then of a purple tint, but its tissues elastic.

Its colour resembles that of a strong infusion of coffee; it is turbid; blood and small coagula are mingled with it, when the protrusion has been long strangulated or protracted and violent taxis employed; now the intestine is dark purple inclining to black; its tissues are leathery, not resilient, infiltrated with blood, and often flakes of lymph are adherent to its surface.

When turbid, dull brownish-yellow, and containing blood, coagula, pus, flakes of lymph, and even fæcoid matter, in which state the odour of fæces is perceptible, the intestine is usually approaching a gangrenous condition, if it have not already passed into sphacelus.

The escape of gas through serum, of the nature last described, producing bubbles, is an indication that the herniated bowel is probably ruptured, and that a communication exists with the interior of the alimentary tube.

If the progress of the disease be not arrested by the liberation of the bowel, its tissues mortify, the coverings of the sac become inflamed, infiltrated with serum, and at last with pus. Crepitation may be felt, which arises either from the development of gases in the decomposing tissues, or depends upon their escape from the alimentary tube; and finally gangrene of the skin ensues, and through the opening caused by the separation of the slough the contents of the intestinal tube escape, and an artificial anus is established.[1]

[1] John Hunter writes: 'It is very curious to observe in hernias, that while the gut is in the sac and alive, no inflammation takes place on the sac or integuments; but the moment the gut becomes mortified or dead, the stimulus of an extraneous body takes place imme-

In cases of entero-epiplocele, after the reduction of the intestine by the taxis, the irreducible omentum sometimes becomes inflamed, and, together with the sac and its coverings, suppurates, sloughs, and becomes detached in the usual manner; the patient subsequently making a good recovery.

Constitutional symptoms induced by the morbid state of the alimentary canal above the hernia.—Many of the general or constitutional symptoms of strangulated hernia are excited by the morbid condition of the part of the alimentary canal above the portion herniated, more than by the state of the hernia itself. The simple obstruction to the passage of the stercoraceous contents of the tube induces severe constitutional disturbance; an illustration of which is afforded by cases where the canal is crossed by fibrous bands, or directly compressed from any other local cause.

There are so many functions disturbed by the retention of the hernia in the sac, that it is very difficult to assign the constitutional symptoms to any single circumstance, such as the constriction of the hernia. Yet it is almost impossible to deny that some very marked influence arises from this single cause alone; for what change is more marked or striking than the cessation of vomiting immediately ensuing upon the liberation of the bowel? The hernia is indisputably the primary and exciting cause; but much of the constitutional disturbance must be referred to those morbid phenomena which progressively arise as the result of mere obstruction of the alimentary canal.

We may consider these effects of obstruction under two heads. First, those produced in the portion of the viscera within the abdomen; secondly, those excited in the nervous, respiratory, and vascular systems.

Effects of obstruction.—That part of the alimentary canal which is between the stomach and the hernia becomes by degrees distended with flatus and fluid of a dark brown colour. The mucous membrane is deeply injected, sometimes of the colour of blood. The serous membrane is also red, from vascular turgescence; and often patches of a deep red tint produce mottling of its surface. After long protracted distension, the contractile tissues of the small intestine seem to lose their function, which in some cases they never regain. When obstruction occurs to a part of the colon, the patient may die from perforation of the coats of that bowel, or even of the cæcum. The portion between the hernia and the anus, whether small intestine or large, is contracted; the mucous and serous membranes are generally pale. The bowel often contains a little tenacious mucus.

Results of peritonitis are seen after death in the form of shreds of plastic lymph adherent to and lying between the coils of the bowels; or a large quantity of sero-purulent effusion occupies the peritoneal cavity.

Constitutional symptoms of strangulated intestine.—The constitutional symptoms which are regarded as indicative of strangulated intestine, when associated with a local tumour in any site of a hernia, become marked and highly characteristic after vomiting has once commenced.

That train of symptoms seems to be mainly due, first, to nervous irritation starting from the herniated viscus, and afterwards to the interruption of the passage of the stercoraceous matter; for any circumstance producing mechanical obstruction causes very similar results. Thus, if any part of the alimentary tube be confined by adhesions, pressed upon by a tumour, or ligatured by a fibrous band within the abdomen, many of the results attending the accident resemble those of strangulated

diately; an outlet is then endeavouring to be made by the inflammation and suppuration of the sac forming an abscess in it; which matter, with the contents of the gut, is brought to the skin. While this is going on, the sound gut within the abdomen, where it passes into the rings, adheres to those rings all round; so that when the abscess is formed, burst, or opened, and the mortified parts sloughed off, these ends of the gut open into the abscess, and not into the cavity of the belly.'—*Hunterian MS. Descrip. Cat. of the Path. Specimens in the Mus. Roy. Coll. of Surgeons of England*, vol. iii. p. 117.

hernia. Likewise somewhat similar symptoms attended ileus, enteritis, and some forms of constipation.

It is perhaps more correct to state that certain characteristic phenomena taking place in association with a tumour, at a site where it is known hernia commonly, or even rarely, occurs, would lead to the inference that a portion of bowel had become strangulated, especially if certain local indications, superadded to mere swelling, also existed.

Usually, the first symptom the patient complains of is vomiting. Upon careful inquiry, however, it is commonly stated, especially if the case be one of old hernia, that more than usual pain had been experienced at the site of the tumour; or that, for some hours before, it was observed to be larger than usual. Nevertheless, so little trouble is sometimes occasioned by the tumour, in the first instance, that patients often attribute the protrusion of the hernia to the effects of the straining in the act of vomiting. Occasionally, too, soon after rising from bed in the morning, the patient complains of nausea, which is rapidly succeeded by vomiting, without being previously aware of the existence of any hernial tumour. This is frequently the history of females, who perhaps have been toiling laboriously the day before. The same likewise happens in persons who, knowing themselves to be ruptured, and having never worn a truss, designedly conceal the fact. So little local inconvenience is sometimes caused by the hernia, that the attention of patient and medical attendant being entirely engrossed by the act of vomiting alone, both remain in ignorance of the existence of the hernia.[1] Upon inquiry it may be elicited, if the patient enjoys ordinary intelligence, that before the nausea commenced, a sudden sensation of uneasiness was felt in the abdomen, especially about the hypogastric region; that this was followed by a repeated desire to go to stool, with tenesmus, and that nothing but a little flatus escaped.

Nature of the vomit.—The composition of the vomit varies at different stages of the illness. At first it usually consists of the substances last swallowed; next, principally of yellow bilious fluid, which after a time changes to a greenish hue; until at last the colour changes to brown, and resembles more or less closely, especially in odour, a mixture of fæces and water. It is then termed fæculent or stercoraceous.

During the active stage of vomiting the sufferer is unable to retain anything in the stomach for any length of time. But as an extreme state of prostration of the nervous system becomes more and more imminent, and also if the narcotic effects of opium be induced, the irritable condition of the stomach subsides, and may cease altogether. The surgeon must not, however, be thrown off his guard by this apparent calm. His anxieties must not cease in consequence of this composed state of the patient. On the contrary, it betokens a most dangerous depression of the vital powers, a degree of exhaustion from which some persons never rally.

The stage of prostration is now established. The pulse, which during the earlier hours of the attack was more full, and beat more frequently than normal, and which, as the vomiting continued, became weaker and more rapid, now beats slowly and with little force. The surface of the body is chilled; the hands and feet are blue, their integuments shrivelled; the aspect of the countenance is one of anxiety and distress; a peculiar expression as of suddenly increased age is very characteristic; the muscular system has lost its tone; the tongue is dry, furred, and frequently

[1] *Importance of searching for a hernia in certain cases.* In consequence, therefore, of the fatal results which almost inevitably ensue if a strangulated intestine be not speedily liberated, it is the paramount duty of every medical man, when called upon to afford relief in cases of continued vomiting, to examine those regions of the abdominal walls in which hernial protrusions take place.

After long hospital experience, during which time the number of cases of hernia coming under our observation has been very large, many of which had been entirely overlooked until the last stage, we feel it our duty to allude to another cause of destruction. Among the poor it has frequently happened that a friend of the sufferer had gone to a chemist's shop to relate the symptoms, and vomiting and constipation being the most prominent, drastic purgatives were prescribed, and repeatedly swallowed by the patient. Thus, not only was valuable time lost, but treatment of the most injurious kind adopted.

brown; and the secretion of urine falls below the normal standard of quantity. At this stage the hernia is sometimes reducible. The most gentle manipulation suffices. This occurs more commonly in inguinal hernia than femoral. It probably depends upon the relaxed condition of the abdominal muscles, and the removal of the constriction they once exerted around the mouth of the sac; in the same manner as chloroform exerts a beneficial influence. Death occasionally takes place at this period of the attack. This fatal issue is attributable to the extreme prostration of the nervous system induced by protracted vomiting; for in after-death examination of such cases we do not discover any organic lesion to cause it.[1]

The next stage, characterised by distinct symptoms, is after the development of peritonitis. But this does not always occur over so large an extent of surface as to excite grave apprehensions for the result. Peritonitis is often purely local, and confined to a small area around the region in which the hernia is situated. Perhaps the local inflammation is only just sufficient to produce adhesions between the orifice of the sac and the protruded intestine. However, when general peritonitis is developed, the usual symptoms of the disease are well marked. Hiccough is especially regarded as an unfavourable indication. Peritonitis, in the most severe form, arises when the walls of the bowel have been perforated by ulceration, thus allowing their contents to escape into the peritoneal cavity. Intense abdominal pain immediately follows this accident, collapse supervenes, and death speedily releases the sufferer.

The last stage is collapse: the sufferer, although not physically dead, yet seems to linger on the threshold of that state. The patient may continue some hours pulseless; the extremities cold, and the breath also; the facial aspect deathlike; the power of speech but slightly impaired; until a sudden change comes over the features, and life has departed.

We have before described the pain felt in the hernial tumour. Besides this there is a peculiar sensation of tightness or constriction referred to the umbilicus. This is a highly characteristic feature of a strangulated hernia. The patient describes the suffering as resembling the effect which would be produced by encircling the mesogastrium with a tightly-drawn cord. To this is sometimes added a dragging sensation, extending from the epigastrium to the hypogastric region.

Pain, regarded as a symptom of peritonitis, is an uncertain indication. This disease frequently exists without much pain being experienced, and even pressure on the abdomen is endurable without causing complaint. Pain is more particularly absent in those cases where peritonitis arises without ruptured bowel. If, however, fæcal extravasation be the cause of the peritonitis, then the pain immediately becomes intense, often agonising, indeed pathognomonic of that occurrence.

Prognosis of strangulated hernia.—Undoubtedly it is to the length of time which the bowel is allowed to remain strangulated, and to the delay in the performance of the operation for its liberation, that the high rate of mortality must be generally attributed. This circumstance cannot be too strongly impressed upon the mind of the patient; nor can the medical attendant act too promptly in the employment of the only treatment which can avert such untoward results.

The late Mr. James, of Exeter, was evidently surprised at the mortality occurring in the hospitals of London when he observes: 'There can be little doubt that the majority of these fatal cases (of hernia) were the victims of time; . . . this, I am

[1] Mr. Obré showed a dissection of a case of entero-epiplocele illustrating this fact, at the Pathological Society (*Path. Trans.* vol. vii. p. 219). A woman, 53 years old, died after four days' strangulated bowel, without receiving medical advice. After death a small portion of intestine was found perfectly strangulated in the left femoral ring; it was intensely blue, but its tissues unaltered. The small intestines were preternaturally red, but not inflamed.

M. Malgaigne also reports a case of the same kind. Strangulation of the intestine had existed eight days, when the woman died. There was neither gangrene, ulceration, nor peritonitis. He then observes that we see that a strangulated hernia excites such an extreme depression of the vital powers that patients may succumb without any anatomical lesions appearing to produce that event (*L'Union méd.* 1854, p. 248).

aware, is an error little imputable to the distinguished surgeons by whom these operations were performed. It is generally the unfortunate patient who is the cause of his own disaster.' [1]

This statement very truthfully represents the state of the case, in some instances, without doubt—in those, for example, in which the patient, being conscious of the existence of the rupture, conceals that knowledge from his medical attendant, or refuses all interference beyond external or internal therapeutical agents. It does not remove the imputation of neglect from him, who, when the case is under his medical care, leaves his patient for several hours in suffering; nor can it justify the delay which is caused by a surgeon who, duly appreciating the nature of the illness, refrains from liberating the constricted bowel, or asking others to do so, after appropriate means have been unsuccessfully employed to return it by the taxis.

We have never known an instance of a patient dying in consequence of the bowel being liberated at too early a period; but we have had to operate upon many whose chances of life were absolutely sacrificed by the inexcusable delay which had occurred before the patient was submitted to the operation. We make this assertion after a large experience, extending over many years.

Why is it that the mortality attending strangulated hernia is so large? How does it happen that every writer upon this disease and every hospital surgeon has to deplore the condition of patients subjected to the operation for the liberation of the bowel? The average annual mortality in this metropolis caused by hernia, and published by the Registrar-General in 1863, amounted to 148.[2] This average was

FIG. 162.—The Injured Tissues of a Knuckle of Small Intestine which had been violently contused during efforts made to reduce it.

The dark shade between the serous and mucous membranes represents blood extravasated in the walls. The whole of the knuckle was gangrenous, although it had been strangulated only a few hours. The lines of ulceration in the mucous membrane are distinctly seen. (Copied from a coloured drawing and preparation in Guy's Hospital Museum.)

calculated from the total number of deaths from this cause registered during the previous thirteen years. The highest number recorded is for the year 1862, viz. 170; the lowest in 1850, 128. We may assume that the increase of population, and greater accuracy on the part of those certifying the causes of death, may account for the difference between these extremes—42. Now, judging from the condition of the cases which have come into hospital under our own care, we believe we are correct in stating that the mortality might be reduced at least by two-thirds if the liberation of the bowel was effected immediately after the failure of judicious attempts to reduce the hernia by the taxis, assisted by proper means, or soon after the vomiting of fluids regurgitant from the intestinal tube. We do not hesitate to pronounce this judgment after carefully ascertaining the facts of the cases which have fallen under our own treatment. For example, in inguinal hernia: of eight fatal cases, three were incurable in consequence of the condition of the bowel, irreparably diseased by long-continued constriction; two others were in a similar state from the bowel having been injured by violent compression employed to reduce it. Cases of femoral hernia are even still more fatal from the causes above mentioned. In twenty out of twenty-

[1] *Practical Obs. on the Operations for Strangulated Hernia*, p. 79, 8vo. 1859.

[2] *Summary of Weekly Returns of Births and Causes of Death in London*; published by the authority of the Registrar-General, 1863.

eight, the immediate cause of death was attributable to the disease of the bowel which had formed the hernia; this morbid state depending upon injury, over which the mere liberation of the bowel exerted but slight influence towards repair. For it should be remembered that the simple replacement of the viscus in the abdominal cavity does not ensure the restoration of its functions; the surgeon only replaces it in that situation where the reparative powers of nature are most likely to exert their influence with activity; and that if the tissues of the hernia, when reduced, are incapable of performing their functions, those of the intestine cannot be performed, and therefore death must ensue. In several of these cases the disease of the bowel was rendered still more surely irreparable by the pressure to which it had been subjected in the taxis; and in two instances the damage inflicted by this means was so great as to have absolutely killed the entire coil of intestine which was in the sac (fig. 162).

But all the causes which produce the morbid conditions of the bowel above mentioned, and more fully detailed in preceding pages, can be prevented. They may not be always under the control of the medical attendant, nor amenable to surgical skill; but we confidently promulgate the doctrine that the salvation of life in cases of strangulated hernia entirely depends upon the liberation of the bowel at the earliest moment practicable; and the converse may be predicated, that the destruction of life will inevitably ensue in proportion to the length of time the constriction has existed, with its constitutional consequences, and the prolonged and forcible taxis employed.

The vital importance of liberating the bowel from constriction at the earliest moment cannot be over-estimated. As upon the speedy accomplishment of this the salvation of life depends, a little precipitate action may even be forgiven, so hazardous is the position of a patient with the bowel strangulated. But, what is the risk attending the operation of exposing the hernial sac, dividing the impediment to the reduction of the hernia, and reducing it, even should the peritoneal sac require to be opened? Practically, none. In comparison with that of leaving the bowel strangulated, it is harmless.

To what cause, then, may we attribute the culpable negligence of those who leave the poorer classes of the community in this most perilous moment—in a condition replete with jeopardy, fraught with results hazardous in the extreme? It would seem that the embarrassment and the delay are caused, not by surgeons being timid and slow to propose a remedy, but from their really being ignorant of the amount of mischief certain to arise by allowing the constriction of the bowel to continue.

We once heard a physician relate the following circumstance: Being asked to see a poor woman who had been vomiting for several hours, he discovered a hernial swelling. He suggested that a surgeon should immediately see the case, intimating that an operation was urgently needed. The gentleman in attendance replied, 'But will it not be desirable to wait until the vomiting has ceased before the performance of the operation?'

Can any principle be deduced from the facts detailed, to serve as a guide in determining the moment at which the attempts to reduce the hernia by the taxis should be given up, not only as hopeless of good results, but fruitful of pernicious effects, and a cutting operation be urged as the only safe means to liberate the bowel from constriction? We may certainly now assert this without fearing the accusation of too great precipitation: when the period has arrived at which it is certain, from the nature of the fluids vomited, that regurgitation of the contents of the duodenum and jejunum has taken place, any delay in effecting the reduction of the bowel is certain to be attended with progressively increasing evils. If there be evidence of regurgitation from the ileum, the condition of the patient is still more hazardous. Even assuming that the case be now seen for the first time at this period, and that attempts have not been made to reduce the protrusion, delay is inadmissible. The administration of chloroform should be recommended at once, with an understanding between the patient and the surgeon that the operation should be immediately per-

formed if, when its anæsthetic effects are fully developed, he fails to reduce the hernia by manipulation.

M. Desault, fully appreciating the injury too often inflicted on the hernia by the injudicious and violent employment of the taxis, wrote: 'Always think favourably of a case of strangulated hernia when the taxis has not been used.'

Several years since I operated upon a case of femoral hernia in a woman who had been labouring under symptoms of strangulated intestine for fourteen days. This was carefully ascertained. The bowel was thickened, and like a piece of leather. Taxis had never been employed, and this patient recovered perfectly.

Treatment of irreducible hernia. Reduction of the hernia by the taxis.—The endeavour to reduce the hernia, which consists in displacing it from its abnormal position, and passing it through the orifice of the sac into the peritoneal cavity, by dexterous manipulation, is termed the use of the taxis. Of course, the first desire upon the part of the surgeon is to accomplish this feat. But all attempts to replace the bowel in the abdominal cavity should be relinquished until the circumstances attending the special case under observation have been carefully ascertained and considered.

The principal circumstances to which attention should be directed are as follows:—

1. The kind and variety of the hernia regarded in its anatomical relations.
2. The duration of its existence: whether it be of old standing and slow formation, or of recent and sudden development.
3. The constitutional condition of the patient at the immediate moment, as influenced by the present illness. The hour at which vomiting commenced; and the variations which have taken place in the composition of the fluids vomited should be determined with exactitude.
4. The state of the tumour. Its usual size when not causing illness; its bulk before vomiting commenced; the changes which have taken place in it during this stage; the pain to which it gives rise, if merely local or extending into the abdomen, with or without manipulation; the condition of its coverings: its probable contents, so far as may be conjectured by the evidence, assisted by touch and sight.
5. The treatment already adopted by the patient, the friends, or other persons, before the observation of the surgeon.

These are all subjects upon which profound reflection and serious meditation are urgently demanded.

Injurious effects produced by the taxis.—It is necessary to state once more that irreparable injury is frequently inflicted upon the herniated bowel by violence used at all stages of the illness. The danger of any mischief occurring by the use of the taxis increases in proportion to the length of time the bowel has been strangulated. This necessarily arises from the tissues of the viscus becoming less and less able to resist the pressure of the hand in consequence of a morbid state due to the constriction.

The principles by which the surgeon should be influenced, when he is desirous to reduce a hernia without the use of the knife, or by the taxis, are these:

1. Before vomiting commences. It is evidence of sound judgment to abstain from manipulation of the tumour in this stage, and until other remedial means have been tried, except with the object of forming a correct diagnostication of its nature. The taxis, unassisted, often fails to replace the protruded viscus, and in many cases upon which we have been required to operate, patients have stated that the vomiting did not commence until after the use of prolonged and forcible pressure of the tumour. If the case be one of old and slowly-forming hernia, commonly reducible, which has become more painful and larger than usual, for a few hours only, the patient should be enjoined to lie on the back, the pelvis being elevated, and the knees flexed. Or, in other words, the abdominal muscles must be relaxed, by posture, as much as possible. Warm fomentations are to be disposed over the

region of the mouth and neck of the sac, especially in children; and the tumour, if it be a scrotal hernia, supported, or never allowed to be pendent, thus dragging on the neck and mouth of the hernial sac by its own weight. The lower bowel may be induced to empty itself by administering an enema of warm water with a long flexible tube, and tincture of opium should be given in doses suitable to the age of the patient. It is desirable, however, that a full dose be given to adults: and with this view thirty drops diluted with camphor-mixture is not too large a quantity. A few hours may be allowed to pass away in order to afford time for this treatment to take effect, unless urgent symptoms arise.

Some patients cannot maintain the posture just described, or it might be highly injudicious to enforce it. The principle of relaxing the abdominal muscles may then be carried out by allowing the patient to lie on the side of the trunk; but even then the hernial tumour must be carefully supported.

Under the influence of this treatment the patient very often falls asleep, and on awaking finds that the protrusion has returned into the abdominal cavity. Now, should that happy result not have occurred, it will be desirable to manipulate the tumour gently, which perhaps has become soft and flaccid. This must be done upon some fixed principle. A successful issue will not accrue unless the pressure employed be directed with intelligence. The anatomical relations of the protrusion with the mouth of the sac and the apertures in the abdominal walls must be carefully considered; and the course or direction which the hernia takes in its descent should be strictly regarded in all efforts undertaken with a view to its reduction. The patient must be disposed in a posture to relax all the abdominal muscles which can in the slightest degree contract around the mouth of the sac. This part of the sac and its neck should be fixed, as far as practicable, with the fingers of one hand, whilst the fundus of the tumour is held in the palm of the other. This proceeding can only be adopted when the tumour is large. The object desired by the manipulator is two-fold: first, to dilate the mouth of the sac; and, secondly, to diminish the bulk of the protrusion. The area of the orifice of the sac may be enlarged by employing the widest part of the body of the tumour as a fulcrum, over which the tissues composing that part of the sac may be stretched. If an enterocele be under treatment, the size of the protrusion may be diminished by partially emptying the tube of its contents; perhaps by relieving the congested blood-vessels: and, in some cases, the tension of the sac is lessened by pressing the serous effusion it may contain into the peritoneal cavity. That fluid being thus disposed of, the operator is enabled to exert a more direct influence upon the hernia.

2. During the stage of vomiting. It behoves the surgeon to be always on his guard in the use of the taxis, when vomiting is coincident with a hernial protrusion. The longer the time, indeed, the vomiting has lasted, the greater the risk in manipulation of the tumour. If before the commencement of vomiting delicacy of handling be important, how much greater now is the necessity for gentleness when the state of the protrusion, as indicated by the symptoms, can be foretold! Before vomiting occurred, the tissues of the bowel were comparatively healthy, and the damage inflicted by pressure induced a morbid state. After vomiting, especially if it has been persistent some hours, and it has become fæculent, the tissues have been rendered morbid by the constriction to which they have been subjected. Ill prepared, then, are they now to resist pressure, and the effect of violence will surely be to bruise or lacerate them.

The measures which were employed in times past to enable the surgeon to apply the taxis with more effect, and which were generally prescribed at this stage of a case of hernia, need no more than simple mention here. An exception may be taken in favour of opium. There is one period at which its administration is attended with decided advantage. After carefully watching cases of strangulated hernia, we believe we have correctly noticed that there is a short interval of repose which continues until regurgitation takes place from the small intestines. This occurs when the stomach is empty, as the result of vomiting two or three times. If this moment be seized, and a full dose of opium in solution, with a little stimulus, be administered,

the hernia may sometimes be reduced by the taxis. But when once the vomiting of regurgitated fluids is an undeniable fact, the inward administration of medicines is pernicious.

We believe the statement to be correct, that all other modes of treatment have been abandoned in favour of the administration of chloroform. Why? it may be asked. An analysis of the effects of those therapeutic agents formerly in vogue shows that they exerted an influence over the constitutional and local causes preventing the reduction of the hernia, similar to that which is now accomplished by chloroform more speedily, more certainly, with less risk to life, and under circumstances much more within control. The constitutional remedies were bleeding, the warm or hot bath, and tobacco-enemata; all of which exert a powerful but uncertain influence over the vascular, nervous, and muscular systems; on which account they cannot be employed without some risk, arising from effects which are often uncontrollable and persistent for a longer period than is desirable. But the anæsthetic qualities of chloroform, together with the complete suspension of all voluntary muscular action induced by the inhalation of its vapour, renders this therapeutic agent of inestimable value, especially in those cases in which the abdominal apertures are under the influence of muscles controlled by the will, as well as stimulated to involuntary contraction by local irritation.

It is especially beneficial in all kinds of inguinal hernia. Its good effects are most striking in cases of hernia into the vaginal process of the peritonæum occurring in infants and youths, as also in those varieties developed slowly in adult life, and which have existed many years. In fact, the operation for the liberation of a strangulated inguinal hernia in middle age and elderly adults is now rarely required in comparison with the frequency of its performance in past years. As soon as voluntary muscular contraction ceases, then the tumour gradually becomes softer or less elastic, under gentle and well-preconcerted pressure, smaller and of different shape, until at last the hernia escapes from the embrace of the mouth of the sac with a sudden jerk.

The sensation the surgeon experiences when it quits the sac and enters the peritoneal cavity is very peculiar and striking. So characteristic is this of the complete freedom of the bowel from constriction, that in its absence the expert surgeon immediately suspects that all is not quite right.

Usually, vomiting ceases after the reduction of the hernia at once. Occasionally, however, it may continue from the effect of the chloroform alone; but the pain in the abdomen is immediately less, and quickly ceases altogether, especially that characteristic, dragging pain across the mesogastrium.

The patient should maintain the recumbent posture for a short time, with the abdominal muscles relaxed. We do not consider it necessary to place a pad and bandage over the mouth of the sac. Diet of a bland nature and semi-fluid consistence may be allowed in small quantities, and all stimulation of the alimentary canal by aperient medicine must be avoided. As soon as the injured viscus has recovered its functions, the bowels will act spontaneously. Stimulants should be administered according to the constitutional depression existing at the moment.

But great caution as well as discretion are necessary qualifications on the part of the surgeon when he manipulates the tumour. During the insensibility of the patient there is considerable risk of bursting the intestine or lacerating the hernial sac. For twelve hours, or even perhaps for twenty-four in old protrusions, after the first vomit, the danger of using the taxis with sufficient violence to burst the bowel is not very great; but so much damage may be inflicted on its tissues as to preclude all hope of the repair of the mischief. When twenty-four hours have expired, during which time the bowel has been strangulated, it may be very easily burst by forcible pressure, especially if during the latter part of that time the patient has been vomiting fluids which have regurgitated into the stomach from the small intestines. If there be hiccough, the taxis is inadmissible.

The indications of burst bowel are very characteristic. If an enterocele, the hernia glides away from the pressure of the finger, and consequently the tumour

disappears. This act is not, however, accompanied with that sudden and peculiar sensation which the replacement of an unburst bowel within the peritoneal cavity produces. The patient immediately complains of severe pain in the abdominal region; vomiting ceases, but retching and hiccough may arise instead; collapse rapidly supervenes, and death closes the scene in a few hours. In some instances inflammation and suppuration have taken place in the sac, and extending to its coverings, an intestinal abscess has been developed. A fistulous opening thus becomes established, which communicates with the interior of the alimentary tube. (See preceding remarks on 'Artificial Anus,' p. 767.)

There is a period, then, 'when the symptoms of the rupture have gone very far, that it is imprudent to reduce it, even if possible; but as it is impossible, perhaps, to tell when the mortification of the gut is gone too far for reduction, it will, in general, be attempted while life exists, with the hopes of a cure. Upon the other hand it may be asserted, or supposed, that if it is not reduced, the person must also die; but this is not so certain as the other; for the mortification of a gut simply does not kill—it only kills from its consequences; and there is a material difference between a mortified gut out of the belly, and one within. The consequence of one within is absolute death; but the one without in general endeavours at a cure, by producing inflammation and suppuration of the parts, which is producing a fistulous orifice, or artificial anus.'[1]

Cold applications.—Considerable advantage attends the application of cold over the tumour. But when either ice or freezing mixtures are used, their action must be widely extended over the mouth, neck, and body of the sac. The local effects of cold are to diminish the bulk of the protrusion, by exciting contraction of its blood-vessels; to retard inflammatory processes; and, by reducing nervous sensibility, to permit an advantageous manipulation of the tumour. Frigorific applications are valuable agents when there may be unavoidable delay in obtaining chloroform, or in liberating the bowel from constriction. The moment for their employment is after vomiting has commenced, and we consider they are more suitable to cases occurring in the adult than in the earlier periods of life. The advantages attending their employment, however, are so trifling in comparison with the injury certain to be inflicted on the bowel by prolonged constriction, that it is safer to proceed at once to its liberation by operation, than to allow any great length of time to elapse in the expectation of an advantage, which is in any case doubtful. In practice, cold applications can only be regarded in the light of very useful prophylactics. After marked indications of strangulated bowel have existed twenty-four hours, cold as a local therapeutic agent is scarcely admissible, as a rule, on account of the delay which must necessarily occur at this important moment.

The distressing thirst, an accompaniment of continued vomiting, is greatly allayed by taking small pieces of ice into the mouth.

The administration of every kind of purgative medicine must be scrupulously avoided in all stages of strangulated bowel. When swallowed, they are usually speedily vomited; and therefore it is sometimes suggested that under these circumstances they cannot produce a bad effect. This, however, is not always the case. We have seen fatal results ensue from diarrhœa quickly supervening after the bowel had been reduced, the exciting cause of which was referable to purgative medicines taken during the stage of vomiting.

A purgative enema seems to exert a beneficial effect occasionally. But after one has been used in the early period of the attack, a repetition of this treatment is perhaps hurtful in the majority of cases.

Many other local and constitutional remedies have been employed with the intention of assisting the reduction of a hernia, and with occasional benefit. But the uncertain result which attends their employment; the disease, which is always progressive in the herniated viscus; and the risk to life, a certain accompaniment of continued strangulation of the hernia, and its attendant consequences—deter the

[1] *Hunterian MS. Cat. of the Mus. Roy. Coll. Surg. Eng.* vol. iii. p. 117.

experienced surgeon from persisting in entertaining the hope of reducing the protrusion by the taxis, after chloroform has been fully administered, and the hernia remains unreduced.

Herniæ have been replaced whilst completely reversing the ordinary position of the trunk, by keeping the head nearest the ground and the pelvis upwards. A patient may be placed in this posture (head downwards) by hanging over the back of a man, or over the side of a high bedstead or sofa, whilst the knees are at the same time flexed. Another method consists in encircling the mesogastrium with a folded sheet or round-towel, and at the same time drawing the contents of the pelvic region from below upwards, whilst the patient lies in a recumbent posture.

When the hernia is but recently strangulated, and it is an object to reduce it as speedily as possible, without a cutting operation, any method suggested which has been once successfully employed is perhaps worthy of a trial.

Injuries inflicted and accidents occurring in the use of the taxis.—These affect the following structures, separately or in combination; but we may consider independently—

Those affecting the hernia; those affecting the sac; and those involving the tissues covering the sac.

The hernia, whether consisting of a hollow or a solid viscus, may be bruised, and its blood-vessels ruptured. Under these conditions blood is extravasated into the tissues composing it, producing either patches of ecchymosis, or, when an enterocele exists, layers of effused blood appear between the different coats of the viscus.

The tissues of the bowel being delicate, they are more commonly subjected to irreparable injury by violent taxis than the omentum. The presence of this structure, perhaps, often tends to prevent the serious mischief just described. The degree of irreparable injury inflicted on the bowel cannot be accurately estimated by the length of time the symptoms of strangulation have existed. Much rather does it depend upon the violence and prolongation of the attempts employed in the taxis. At any moment during the first twenty-four hours succeeding the first act of vomiting, the entire portion or coil of bowel in the sac may be so disorganised by pressure, that its vitality is entirely destroyed, and so literally killed, that nature throws off the part by the processes usually attending the separation of living from dead tissues. Under these circumstances, the entire calibre of the canal is divided, and an artificial anus is formed: or death takes place in consequence of extravasation of the stercoraceous material into the peritoneal cavity. Sometimes the tissues of the bowel are cut by pressure against the orifice of the sac, or the structures surrounding it; as in femoral hernia, against the free edge of Gimbernat's ligament. (See fig. 162.)

After the expiration of twenty-four hours, the constriction to which the bowel has been exposed having led to inflammatory effusion into and softening of its textures, there is great risk of bursting the tube. This rent usually occurs at the convex border of the gut, at the farthest point from the mesentery, and corresponds with the direction of the circular contractile fibres.

Another effect of violent compression is to cause the mixture of blood and coagula with the serum in the sac, and flakes of lymph or puriform effusion arise from the same injurious interference. The local and constitutional indications of these injuries have been described in a preceding page.

Injuries of hernial tumours by accidental violence.—We may here briefly describe the treatment of those injuries which happen to hernial tumours from accidental circumstances, during the pursuit of the ordinary avocations of individuals afflicted with reducible as well as irreducible ruptures. The reader will derive more information on this subject than it is possible to introduce here, by the perusal of a most interesting paper entitled 'On the Proceeding to be adopted in a Case of Injured Intestine from a Blow on a Hernial Sac,' by the late Mr. Aston Key.[1]

A simple contusion is the mildest form of injury. Should the signs of more

[1] *Guy's Hospital Reports*, 1842, vol. vii. p. 261.

severe mischief be absent, the hernia may then be returned. It is important, however, that the patient abstain from bodily exertion, and the alimentary canal be kept in a state of repose. If the violence of the blow have been sufficient to cause inflammation and ulceration of the gut, the slightest indication of any such secondary mischief must be watched with the most anxious care, and the favourable moment seized when an incision into the tumour will allow the escape of the contents of the alimentary canal, and by this proceeding avoid the risk of extravasation into the peritoneal cavity.

But when there are plain indications that the primary effect of the violence has been to lacerate the intestine, which by chance was contained in the sac at the moment the injury was inflicted, time should not be wasted in adopting palliative measures; but the hernial sac must be freely cut open, and thus a ready means of escape be made for the stercoraceous fluids. The symptoms indicating a wound of the intestines are described in the essay on INJURIES OF THE ABDOMEN.

Another variety of injury of a hernial tumour is when the patient has an irreducible epiplocele. The omentum is adherent to the mouth of the sac, and entirely blocks it up, as it were, whilst the body of the sac remains as a simple closed serous cavity. A contusion of such a tumour excites inflammation and suppuration within the sac. Considerable embarrassment may be experienced in precisely diagnosticating the exact nature of the disease.

Injuries of the hernial sac.—There are two varieties of injury which produce important effects on the sac containing the hernia. Both of them render a case of strangulated hernia exceedingly complicated and embarrassing. The violence causing the mischief may be applied to the tumour either by the sufferer or another person; but considerable force is requisite to rend or tear the tissues composing the sac, or to separate it from its surrounding connections. These injuries more frequently happen in association with long-continued pressure than after short trials of the taxis. The two varieties are as follows:

A. *By displacement.*—The sac is detached, to a greater or less extent, from the surrounding structures. Those parts of the sac called the orifice and neck are more frequently affected by this injury than any other portion. They become detached from the inner surface of the internal abdominal fascia. Together with these, that portion of the parietal peritonæum immediately circumjacent to the sac's mouth is also severed from its attachments, and in this manner a pouch is formed within the fascial membrane of the abdomen, into which the hernia may be forced; and being retained therein, is lost to touch and sight. Sir Charles Bell has recorded a case which illustrates this injury.[1]

It is stated that the entire hernial tumour may be pushed within the abdominal walls, in a mass, whilst the hernia is still strangulated by the orifice of its sac. This injury was first described by French writers, under the appellation of 'réduction en bloc.' However, of late, examinations made after death indicate other lesions to be the probable causes of the disappearance of the hernia, in some cases; and certainly afford conclusive evidence that such an accidental disposition of the sac, when strictly examined in an anatomical point of view, must still be regarded as a very rare occurrence indeed. We refer the reader to Mr. Luke's paper for further information.[2]

In offering the following explanation of many of these cases, we court the inquiry of future observers, to support its correctness or to prove it to be erroneous.

The tissues of the scrotum are very loose, and readily change their position. Every observer must have noticed the variable length of the spermatic cord, between the external abdominal ring and the testis at different times. The hernial sac, attached to the anterior surface of the spermatic cord, also varies in length in like manner. When the hernia occupies the sac, the latter extends lower than when it is empty, in which last state it perhaps only just emerges from the inferior outlet of the inguinal canal. Now let its mouth and neck be detached from the internal ab-

[1] *Lond. Med. Gaz.* 1828, vol. i. p. 485.
[2] *Med.-Chir. Trans.* 1843, vol. xxvi. p. 159.

dominal ring, and the hernia still strangulated by the margins of the orifice be pushed inside the abdominal walls. The fundus of the sac attached to the tissues of the scrotum is not on this account severed from those connections, but merely ascends towards the inguinal canal, and lies partially within it with its walls in close contact, which, being rather thin, are not very recognisable. The fact that this part of the hernial sac has been often found in this situation during the progress of an operation for the liberation of the strangulated gut, is attested by the reporters of those operations.[1]

B. *By laceration or bursting.*—As the effect of forcible and long-sustained compression of the hernial tumour, the delicate serous membrane of the sac is rent, burst, or torn, and the hernia makes its escape through the aperture into the subserous connective tissue. Its course outside the peritoneal sac is advanced by continued pressure; and detaching the connections of the neighbouring peritonæum, it forms for itself a pouch between that serous membrane and the internal abdominal fascia.

The part of the sac a little below its abdominal orifice or mouth, usually styled the neck, which lies in the inguinal canal, is most frequently burst along its posterior surface. This injury is more commonly produced in that variety of inguinal hernia, the sac of which is constituted of the vaginal process of the peritonæum, whether the hernia be in contact with the testis or not. It is inflicted with remarkable facility when the patient is fully under the anæsthetic influence of chloroform, especially if he be also youthful. This accident is easily imitated, after death, upon a subject in which the neck of the hernial sac happens to be rather long, by cutting an opening in its posterior wall, and pushing the finger in a backward direction. The course which the finger takes is that one which the hernia would pursue.

The indications of the accident having taken place are as follows: the tumour becomes flaccid, and therefore smaller, which alteration in its features is probably owing to the serum which the sac contained being squeezed through the rent into the connective tissue around the sac; the bulk of the tumour slowly diminishes as the pressure is continued, until at last very little, if anything, can be felt, but the surgeon has failed to experience that sudden jerk so characteristic of the escape of the hernia from the gripe of the mouth of the sac, as it enters the abdominal cavity; and if he have had much experience of the reduction of hernial protrusions, doubts will arise in his mind as to the probable direction this one has taken. After the effects of the chloroform have passed away, all the symptoms of strangulated bowel recur, and perhaps with increased force. Even the tumour itself may reappear, and recede on the application of slight pressure.

Now all these circumstances are highly characteristic of the accident that has occurred; and there remains but one proceeding to be adopted immediately. It is this. The hernial sac must be exposed and opened. Perhaps it may appear to be empty; and even the finger passed upwards and along the inguinal division of the sac enters a cavity through a well-defined aperture, in which intestine is felt. This abnormal aperture may be mistaken for the internal ring and the cavity into which it leads, that of the abdomen. Acting upon this belief, however, would lead to the commission of a fatal error; one which, if not detected at the moment, will surely compromise the life of the patient. An effort must now be made to draw the bowel out, if it does not come forth spontaneously; and when this is accomplished, the true mouth of the sac will be discovered by passing the finger upwards along the anterior surface of the mesentery. By the orifice of the hernial sac the protrusion is firmly constricted. The constricting tissues, therefore, require to be cut; after which operation, the exercise of great care and caution is needed to prevent the entrance of the hernia once more into the abnormal space outside the peritoneal cavity. As the salvation of life depends upon the return of the protrusion through the natural orifice of the sac, considerable freedom in the use of the knife is justifiable, if the attainment of the desired end is thus facilitated, and the risk of failure in doing this thereby removed. All cases of this description not only give rise to great embarrass-

[1] *Med.-Chir. Trans.* 1859, vol. xlii.; see tables at end of paper, p. 278.

ment and difficulty, but they are also associated with very unfavourable consequences and results.

Injuries to the coverings of the hernial sac.—A very short description will suffice to indicate the nature and effects of the injuries inflicted on the tissues covering the sac by the use of unjustifiable violence in attempting to reduce a hernia by the taxis. We have seen the results of contusion; namely, ecchymosis of the integuments; extravasation of blood and œdematous infiltration into the subcutaneous tissues covering the sac; and inflammation of all the structures together, passing on to suppuration, sloughing, and phlegmon, extending to the neighbouring regions. Those local morbid conditions require the ordinary topical measures suited to them.

The disappearance of the hernia in consequence of its passage from one sac into another;—intra-parietal.—We may here allude to those rare cases of inguinal hernia which are complicated with an intra-parietal sac. Anatomically examined, the hernial sac in these cases consists of two parts; that division which passes along the inguinal canal into the scrotum, and that one which is lodged in the walls of the abdomen. A full description of these curiously developed sacs is given in the section of this paper devoted to inguinal hernia. Now when the hernia is strangulated by the ventral orifice of the sac, and it occupies the scrotal division, it may be pushed by the taxis, even when employed with the utmost care and skill, into the other sac, and thus, the tumour disappearing, the surgeon considers the hernia reduced. The constitutional symptoms, however, quickly indicate that this is not the case. By inducing violent action of the abdominal muscles, or making the patient stand erect, the hernia will sometimes reappear. Under any circumstances, the liberation of the bowel is demanded, and in the necessary operation to accomplish this end great care is required to avoid passing the bowel from one sac into the other, instead of into the abdominal cavity.

The operation for the removal of the impediment to the reduction of the bowel, or the liberation of the hernia.—The culminating point in the treatment of every case of strangulated enterocele is reached when the impediment to the reduction of the bowel must be removed by a cutting operation. This of course occurs after the failure to reduce the protrusion by the taxis.

The part of the practical surgeon is not only to know truth, but to apply it; and however repugnant to the feelings of the patient or creative of alarm the thoughts of an operation may be, it is his paramount duty to urge concurrence in this step, as it alone offers the surest prospect of the salvation of life.

By too many medical men the cutting operation seems to be regarded in the light of a last resource, and one which it is improper to use until danger to the life of the patient appears imminent. But the sooner that this fatal error is eradicated, the sooner shall we discover upon what fallacious views it has been based. We believe that death resulting from strangulated bowel would be a rare occurrence, if it were practicable to return every strangulated enterocele within twelve hours after the commencement of the symptoms, even assuming that the cutting operation be required to accomplish that end in every case. For let this conviction be firmly impressed upon the mind, that death results not from the operation, but because the operation was not performed at the right moment.

Every medical attendant upon a case of strangulated hernia should reflect on these indisputable facts, that so long as the viscus remains in that condition the life of the patient is slowly ebbing; that to his judgment and foresight has been committed the safety of the sufferer; and that upon his discretion, firmness, and resolution hangs the fatal issue. For it is no exaggeration to say, that each minute as it elapses carries with it the chances of recovery further and further away.

We hope that the mortality arising from strangulated hernia is not now so large as it once was.[1] Nevertheless, at this moment it is excessive; and when we know,

[1] Mr. Hey states, that when he entered upon the profession of surgery, now one hundred years since, 'the operation for the strangulated hernia had not been performed by any of the

and all professing surgery should know, how surely the liberation of the bowel tends to save the life of the patient, why is it not done the moment all other measures have failed to replace the gut in the abdominal cavity? Some medical men do not seem to be sensible of, or to appreciate the vast amount of injury which is certain to accrue from the persistent vomiting, nor to value the indications derivable from the character of the vomit. They most assiduously attempt to check the vomiting by administering medicines; but they utterly reject, at the suitable moment, the only means by which it is to be arrested.[1]

The operation, kelotomy, herniotomy. The first part of the operation consists in cutting through all the tissues covering the hernial sac, carefully recognising their characteristics as they differ in the special regional varieties of hernia. Having reached the sac containing the strangulated viscus, the operator now determines upon the propriety of opening it and exposing its contents to sight and touch.

If he determines to cut the sac open, it should be done in this manner. The body of the sac is nipped up between the finger and thumb, and with exceedingly great care, to avoid at the same time including the walls of the bowel. An opening sufficiently large to admit a grooved director is next made with a scalpel, the sharp edge of which must not be directed towards the contents of the sac, but laterally. The side of the blade should be placed nearly flat on the tumour. By this management of the instrument, all risk of injuring the intestine is removed. A grooved director having been passed through the opening and firmly held against the inside of the sac, rather indeed stretching its tissues over it, they are freely divided, upwards and downwards, or towards its orifice and fundus.

Usually the escape of more or less serum is a sufficient indication that the hernial sac has been opened. But the operator should not be thrown off his guard by an absence of serum, when the sac has been cut, any more than by seeing a flow of fluid when it has not been even reached. The latter somewhat rare occurrence is due to the development of a cyst upon the hernial tumour, and is at once explained by passing the finger into a circumscribed cavity. For the variable conditions of the serum, see p. 769.

When an enterocele is under treatment, the intestine is brought into view as soon as the sac is opened; but in an entero-epiplocele it often happens that the omentum only is exposed. The surgeon then carefully raises this structure, for the bowel lies underneath in the majority of cases. It is wholly enveloped by it in some instances, when that arrangement termed an omental sac exists. In this case the omentum

surgeons in Leeds;' and he adds, that he 'lost three patients in five upon whom the operation was performed' (*Practical Obs. in Surgery*, 3rd edit. 1814, p. 129). Are the results of the treatment of strangulated hernia more successful at the present day? We fear not.

[1] We may have expressed our views a little strongly, and thus laid ourselves open to criticism and animadversion; for we confess to have been a little influenced whilst writing these lines by an occurrence which took place at the time of doing so. A fine woman for her age, which was 71 years, known to be the subject of strangulated femoral hernia, was allowed to vomit persistently for between ten and eleven days. At this time she was sent to the hospital 'for the operation,' which necessitated a journey of several miles. She arrived cold and pulseless, though intelligent; the abdomen was tympanitic: she was in fact moribund. As soon as practicable the liberation of the bowel was effected. The escape of purulent fluid from the abdomen was sufficiently characteristic of the condition of the peritoneal cavity. In spite of warmth applied to the surface of the body and stimulants administered internally, she expired in a few hours after admission. Yet, during the ten days preceding, medicines had been prescribed to arrest the vomiting, taxis had been frequently employed, and the marvel was, as a friend who accompanied her expressed it, that she reached the hospital alive. What other result than death could have been anticipated? *Ten days* vomiting, and starvation for the same period, was surely enough to destroy life at the age of 71 years; but, in addition, she had a perforating ulcer at the point of junction of the upper division of the alimentary canal with the hernia, extravasation of stercoraceous matter, and diffused peritonitis. Nor is this case an isolated example of culpable negligence. Instances already recorded in books, and abundantly exemplified by reports in the weekly medical journals, abound in the metropolitan and provincial hospitals. Such misfortunes—for we deem it to be a misfortune that hospital surgeons have to treat cases of this kind—would never occur if the medical attendant could but be made to feel that his patient lies within the jaws of death until the intestine is returned into the peritoneal cavity.

requires to be carefully unravelled. We employ the last word in order to insure the use of much care and caution in the division of its tissues.[1]

The condition of the bowel should be now carefully ascertained, for by the morbid state of its tissues the surgeon determines upon the propriety of placing it within the peritoneal cavity, or allowing it to remain outside of the abdomen. Simple adhesions of the bowel to the body of the sac may be gently broken down; but the greatest caution is required in this treatment of the hernia where it lies within the orifice of the sac, as by rough manipulation its tissues may be torn, when extravasation of the contents of the tube into the peritoneal cavity will take place. If the bowel is ruptured, it must be confined to the edges of the wound by sutures.

To reach the impediment to the reduction of the hernia, the point of the index-finger is now directed upon the anterior surface of the mesentery, towards the mouth of the sac. Should the end of the finger pass freely through the ventral orifice of the sac into the peritoneal cavity, when introduced with great gentleness, an attempt may be made to reduce the hernia without cutting this part of the sac. In the manipulation of the bowel great delicacy is required. The surgeon gently presses the distended coil, and if its fluid or gaseous contents escape into the continuity of the canal, it soon becomes flaccid. This condition may be regarded as an indication that the protrusion is reducible without cutting the orifice of the sac. On the contrary, if after delicate and continued digital pressure the knuckle of intestine continues to be tense, elastic, and round, the surgeon decides to enlarge the mouth of the sac by cutting it. Operators with little experience would do well to make use of a grooved director. This instrument is carefully passed upon the anterior surface of the hernia, its direction being guided by the index-finger of the left hand. It should be introduced into the abdomen sufficiently deep to be entirely clear of the constriction formed by the tissues around the protrusion, but not further. Careful examination is necessary at this step, to ascertain that the bowel does not overlap the borders of the director, nor lie between it and the anterior region of the neck and orifice of the sac. To avoid all risk of injury to the bowel, when that viscus is quite clear of the groove in the director, the instrument should be firmly pressed against the tissues which are about to be cut. A bistoury, specially constructed for this operation, is gently glided along the groove on the director, and a slight resistance is usually encountered as it passes through the constriction, which, however, yields as the cutting edge reaches, and in its passage divides, those tissues which cause the impediment to the reduction of the hernia.

When those tissues are firm and rigid, a sound is produced, or a peculiar sensation is felt, on dividing them resembling the cutting of thick leather. The operator now employs the index-finger to examine the opening he has made. If it feels sufficiently large to admit the passage of the hernia, he next attempts its reduction; if it prove still too contracted, the bistoury may be passed along the finger and the incision increased. The impediment to the reduction of the hernia being thus entirely removed, its replacement within the abdominal cavity is easily effected.

The following, then, are the principles upon which every step of the operation must be based: exact anatomical knowledge; the exercise of deliberate consideration and judgment; the recollection of the necessity for practical care, and for delicacy of manipulation, and of the importance of interfering as little as possible with the surrounding structures. Just so much must be accomplished as is absolutely needed, and no more.

But we must revert to a few subjects merely alluded to in the preceding description of the operation.

Of opening the hernial sac.—When the anatomical relations of the hernial sac were carefully examined, it was discovered that the impediment to the reduction of the hernia was not in all instances caused by the narrow passage of the ventral

[1] A very interesting paper on these 'omental sacs,' written by Mr. Prescott Hewett, is published in the *Med.-Chir. Trans.* 1844, vol. xxvii. p. 282; and another, on a case of scrotal hernia with compound omental sac, in *Path. Trans.* vol. iii. p. 98.

orifice of the sac alone. Careful dissections showed that those structures which lie in close connection with the outside of its mouth and neck offered considerable obstruction to the retrograde passage of the hernia through those parts of the sac.

For the last hundred years surgeons of eminence have applied these anatomical facts to treatment, and many distinguished operators have dwelt upon the advantages to be derived from replacing the hernia in the abdomen without cutting open the peritoneal sac. On the grounds above alluded to, they have devised that mode of performing the operation for a strangulated enterocele called 'the division of the stricture without opening the sac,' or 'external to the hernial sac.'

The advocates of the operation believe its most favourable points to be as follows: the peritoneal cavity is not opened; the peritonæum at the mouth of the sac is not cut; the diseased intestine is not exposed to the influence of the atmospheric air, nor to the direct contact of the fingers of the operator; nor is the risk of hæmorrhage into the peritoneal cavity so great, should a large vessel be accidentally cut. They consider, moreover, that the operation itself is not attended with the same amount of danger as when the peritoneal cavity is opened, its parietal reflection cut, and the inflamed bowel exposed.

The simplicity of the proceeding commends the operation highly; for the wound inflicted is very little more than an incision through the integuments, and its advantages must have seemed paramount at a time when the dangers of the operation were exaggerated, and it was assumed that patients with strangulated hernia died from the effects of the operation itself.

Bearing in mind, however, that death occurs from the constitutional and local effects of long-continued strangulation of the bowel and its injury by forcible taxis, and because the bowel is not liberated by the operation early enough, the advantages of any particular mode of operating, especially of this one, are perhaps not quite so great as at one period many surgeons were inclined to admit. The method of performing the operation is quite a secondary consideration, in comparison with the importance of the early liberation of the bowel.

The opponents of this operation enforce their objections with the doctrine that, when the necessity arises for any cutting operation at all, the fact alone is sufficient to demand an incision into the hernial sac, in order to ascertain the cause of the impediment to the reduction of the hernia; and that an operation for the liberation of a strangulated bowel is not complete until that viscus has been carefully examined. They also regard the risk to be great of reducing the hernia, still strangulated by adhesions, omentum, or even by the orifice of the hernial sac itself.

Next, pointing to statistical facts, and comparing the results of the two operations as performed in different metropolitan hospitals—in those where the preference is given to opening the sac in all cases, and in those in which the opposite plan is pursued—they maintain that the greatest success is obtained at those institutions where the sac is incised as a rule.

It is, however, quite clear that we are unable to collect any facts upon which to institute a safe comparison. Conclusions as to the success of the one practice or the other, based upon the results of the cases under treatment, in the hospitals, are really worthless, because the incidents in any two cases of hernia are never precisely alike, and accuracy, as to details, which is absolutely required to arrive at the truth, cannot be obtained.

We believe the dictum to be equally erroneous, when one surgeon says that in every case the sac must be opened, and another directs that it must not, except by compulsion. The proper practice consists in making a judicious selection of the cases: viz. those in which the operator opens the sac upon a fixed principle; those in which he does not, because, according to his judgment and experience, there is no necessity to do it.

In many of the metropolitan hospitals the operation external to the sac is performed in suitable cases, upon conviction of its advantages; and although we dare not venture to say that some of the fatal cases which have occurred after opening the sac might not have terminated differently had it not been incised, we do not hesitate

to affirm, that the untoward circumstances stated as likely to happen, when the sac is not opened, have not occurred.

Doubtless every hospital surgeon to whom the opportunity occurs of frequently operating on cases of strangulated hernia, will be guided by his own judgment as to the propriety of opening the hernial sac in every case, or of leaving it intact in selected cases. But if we may be permitted to enunciate the principle upon which inexperienced surgeons may act with safety, it would be this. In all those cases in which the surgeon would deem it safe to return the hernia by the taxis, if it were practicable, he may do the same thing after he has removed the impediment to the reduction of the hernia, by cutting those tissues lying outside the sac which are the cause of that impediment. But in those cases in which the symptoms are suggestive of an aggravated morbid condition of the bowel, and on account of which it would be improper, nay hazardous, to attempt to reduce it by the taxis—in those the sac must be opened.

In making a suitable selection of the cases for the first plan, great discrimination is therefore required. We regard those cases to be favourable for the operation in which the symptoms of strangulation have existed but a few hours, and when they have not been very severe: when the vomiting is not stercoraceous, nor the patient very prostrate; when the tumour is a simple enterocele, and when it has escaped forcible attempts at reduction. Of course no cutting operation of any kind will be attempted until after the failure of well-applied taxis to reduce the hernia.

On the contrary, the indications for incising the sac are: a long continuance of the strangulation of the hernia; inability to empty the sac completely; the persistence of stercoraceous vomiting; the prostration of the patient; the compound conformation of the tumour (it being an entero-epiplocele); and after repeated, protracted, or forcible taxis has been used.

Guided by these facts, the number of cases in which the operation of division of the impediment to reduction of the hernia external to the sac may be regarded as preferable to any other, becomes very limited. But we cannot refrain from expressing our conviction, founded upon the results obtained in those cases in which this operation has been carried out, that it is easy of performance, free from the risks attributed to it, unaccompanied by some of those accidents which occasionally occur when the sac is opened, and most favourable to the rapid recovery of the patient. It must, however, be remembered that these are select cases, and belong to a class most favourable for recovery; and we cannot deny but that they would probably be successful, even should the peritoneal sac be cut open.

Nevertheless, the inquiry suggests itself, If the hernia can be reduced with safety without opening the peritoneal cavity, why should it not be?

Of the instruments required to perform the operation.—They are as follows:

An ordinary scalpel, with a single cutting edge; forceps; a grooved straight director; a grooved director, specially adapted for insertion beneath the tissues forming the impediment to the reduction of the hernia; a bistoury of peculiar construction, with which to cut those tissues; retractors.

The director and the bistoury are the only instruments requiring special notice.

The director has been constructed after a great variety of forms—straight and curved; long and short; narrow and wide; with wings or lateral projections to protect the bowel from the knife; with or without a handle affixed; with a probe-pointed end or beak, with the groove terminated, near the end, by a stop, or without such a stop. That form of the instrument invented by the late Mr. Aston Key has been employed under our observation many years with advantage; and we are able, therefore, to recommend its use. It is usually known as Key's hernia director.[1]

The bistoury, used to divide the tissues which constitute the impediment to the reduction of the hernia, wherever they may be situated, has been made in a great

[1] A drawing representing this instrument may be seen in Mr. Key's *Memoir on the Advantages and Practicability of dividing the Stricture in Strangulated Hernia on the outside of the Sac*, 8vo. Lond. 1833 Drawing 1.

variety of shapes, lengths, and breadths, and usually with some contrivance, movable or fixed, to prevent its end and cutting edge injuring the intestine. It being impossible to describe every variety of the instrument, perhaps it will suffice to state the characteristics of a good one for safely performing this important part of the operation. It is desirable to have two bistouries at hand, one straight, the other curved. When the ventral orifice of the sac is deeply seated, the latter will be found very useful. In other particulars the two instruments resemble each other. The metallic part extends about $3\frac{1}{2}$ inches beyond the handle. Its sides are $\frac{3}{8}$ of an inch broad where it unites with the handle, and they gradually taper towards the end, where the breadth is $\frac{1}{8}$ of an inch. The blade terminates in a button or blunt end. At the terminal $\frac{3}{8}$ of an inch, the sides of the metal are bevelled off, and one edge is made to cut. This sharp edge should be slightly concave. All the other edges and surfaces of the metallic shaft are carefully rounded off and polished. Sir A. Cooper's hernia-knife has a cutting edge $\frac{6}{8}$ or $\frac{7}{8}$ of an inch long, beyond which extends a blunt terminal portion $\frac{3}{8}$ of an inch long. The objection we entertain to this knife relates to this long blunt beak, which must be passed into the abdomen before the cutting edge reaches the tissues which require division.

When the index-finger, of either hand most convenient to the operator, is employed as a director, its point is passed to the orifice of the sac, outside or inside; the bistoury is passed upon the anterior surface of its first phalanx, and the side of the instrument being pressed against it, lies in a depression on its soft parts. Thus the sharp edge of the knife is prevented from injuring the bowel. The end is then dexterously insinuated beneath the tissues to be cut; and as they slowly yield before it, the finger follows the direction of the knife, and the operator judges of the size of the opening he is making by the facility with which his finger passes into the abdomen.

When a metallic director is used, the bistoury is gently carried along the groove of the instrument.

Of the treatment of the strangulated intestine.—The primary object of every surgeon who has a case of strangulated enterocele under his charge, should be the return of the intestine into the abdominal cavity as quickly as possible. With this object in view, 'the operation,' as it is termed, is undertaken after the failure of all other means.

But there are certain morbid states of the bowel which preclude the operator from doing this, after the liberation of the viscus from the constriction to which it was subject. The morbid conditions having been already described (p. 766), we need only briefly refer to them here, in order to direct their treatment.

Commencing, then, with the worst condition, in which the entire knuckle of the intestine in the sac is dead, mortified, or sphacelated. Before the operation, adhesions will have formed between the coils of bowel in the abdomen, as well as between them and the parietal peritonæum in the vicinity of the margins of the mouth of the sac. It would be very injudicious interference with the processes of nature to break down these adhesions. They are the result of peritonitis; and this form might be termed protective, for its effects, especially the adhesions, may possibly prevent the extension of the peritonitis, and the mischief which would certainly accrue if the contents of the alimentary canal escaped into the peritonæum.

It is sometimes difficult to find the end of the upper portion of the alimentary tube, from which the stercoraceous matter escapes; meddling with the processes of nature is not desirable, and therefore, unless the perforated viscus is easily reached, it is better to leave the parts as they are, exposed. The edges of the wound should be left free and open, in order to allow a ready escape for the contents of the bowel. In this manner an artificial anus is established. Should the open end of the gut be accessible, one, two, or more sutures may be inserted through all the structures constituting its walls, and they may be thus fastened to the integuments.

If there be a small perforation in any part of the herniated viscus, the result of disease, there are generally adhesions within the abdomen, which prevent the

extravasation of its contents into that cavity. When, therefore, the opening does not involve the whole calibre of the canal, the herniated viscus may be placed just within the abdomen; for sometimes the aperture will entirely close, even after stercoraceous matter has freely flowed through it for several days. Even a ligature may be tied around a small hole in the intestine with the best results. This treatment was successful in a case reported by Dr. P. H. Watson, of Edinburgh.[1]

Should the intestine be accidentally wounded, the cut edges may be carefully drawn together by using the glover's suture, and returned just inside the mouth of the sac.

When the tissues of the herniated bowel are not perforated, but appear to be in such a morbid condition as to induce the operator to fear that their restoration to a healthy state is improbable, although just possible, the hernia may be returned if the adhesions at the neck of the sac are not strong. The late Mr. Aston Key advocated this plan of treatment. He did this upon the principle that the abdominal cavity was the place in which the injured bowel was more likely to be repaired than in any other. 'The danger of abdominal extravasation will not be increased by replacing the injured bowel at the neck of the sac; for, should sloughing of its coats ensue, the slough may be walled-in by adhesion of the surrounding peritonæum, and fæcal extravasation be prevented.'[2] When adhesions prevent this treatment, it is better to divide the orifice of the sac slightly, and to leave the bowel in the sac. Under such unfavourable circumstances, patients occasionally recover without a fæcal fistula. An interesting case of this kind is published by Dr. Watson, in the 'Edinburgh Medical Journal,' March, 1870.

In some cases the operator encounters great difficulty in reducing the hernia, even after the mouth of the sac has been freely enlarged. This depends upon the following causes:—

1. *Its bulk.*—The hernia sometimes consists of a very large quantity of intestine, which is distended with flatus: and although a portion is reducible, the reduction of the entire mass is impracticable. After the failure of these attempts, a plan may be pursued which was adopted by Mr. Tatum with complete success.[3]

The bowel may be punctured, and the flatus allowed to escape. Mr. Tatum used a grooved needle for the purpose; we would suggest the employment of the filiform trocar and cannula. This instrument may be obliquely inserted through the tissues of the bowel, thus forming a valvular wound.

2. *Adhesions.*—These may be *recent* and *chronic*. The latter are often formed long antecedent to the conditions for which the operation was undertaken. In the recent state the adherent surfaces are usually easily separated, whether they unite the coils of the bowel to one another, to the sac, or to the omentum. When this morbid condition happens to the viscus *in* the body of the sac, there is not much risk of the interference making mischief; but when the bowel is adherent to the mouth of the sac, the condition usually indicates an advanced morbid state of the viscus. It is an indication that nature has made preparations to prevent extravasation into the peritoneal cavity, in the event of the bowel bursting from the distension caused by accumulations in that part of the digestive tube above the hernia. Meddling with such adhesions is attended with great risk of tearing the bowel. The safest procedure is to reduce the protrusion, if possible, after having enlarged the mouth of the sac; but, even allowing it to remain in the sac, relieved from constriction, would be preferable to lacerating the bowel in the attempt to separate the adhesions, and so establishing an artificial anus. Recent adhesions to other structures may be separated with ease. Flakes of adherent lymph had better be left where found. By detaching them, the coats of the bowel may be torn; and they frequently overlie small sloughs.

Enteroceles of long standing sometimes become permanently united to a part of the sac, although very rarely. In such cases the orifice of the sac is usually large, and the chance of the bowel becoming strangulated proportionately remote. The

[1] *Edinb. Med. Journ.* July, 1869 [2] *Guy's Hospital Reports*, 1842, vol. vii. p. 264.
[3] See INJURIES OF THE ABDOMEN.

peristaltic action of the canal proceeds as usual in the hernia, with occasional inconvenience arising from accumulations, therein causing obstruction. Should an operation be required, two proceedings may be adopted: either the orifice of the sac may be enlarged, and the intestine left in the sac; or the adhesions of the viscera may be destroyed, and the bowel returned. The choice of these two plans might be decided by the condition of the viscus and the extent of the adhesions.[1]

3. *The depth and inaccessibility of the mouth of the sac.*—That part of the sac which lies in close relation with the general peritoneal cavity is sometimes so deeply seated, that considerable embarrassment arises not only in making its orifice larger, but in returning the hernia into the peritoneal cavity when that has been done. By employing an assistant, who carefully holds the opened hernial sac by its cut edges, to draw it forwards and outwards, or from the abdomen, its mouth is more fixed and slightly stretched. This manœuvre greatly facilitates the reduction of the protrusion.

Treatment of the omentum.—Omental protrusions or epiploceles rarely require the removal of the impediment of their reduction by a cutting operation. But after the return of the intestine, in cases of entero-epiplocele, it often becomes a question what is to be done with the omentum.

The treatment is as follows: it may be reduced; left in the sac; cut off; or a ligature tied around it.

The first proceeding would be generally chosen when practicable. In some instances, however, the great bulk of omentum, or its diseased condition, necessitates a choice between either leaving it in the sac or removing it.

There are some disadvantages in leaving the omentum in the sac: the fat becomes inflamed; it suppurates, and sometimes sloughs; the healing of the wound is consequently delayed, and the after-treatment of the case thereby protracted. Usually, however, the omentum shrinks, and eventually the wound heals, but with more or less of a tumour at the abdominal aperture. This swelling may interfere with the successful application of the pad of a truss. Some surgeons, however, believe the remains of the omentum to be useful in blocking up or plugging the ventral aperture.

The removal of either the whole or a part of the protruding omentum may be effected by cutting it away at once, or by applying a ligature around it near the orifice of the sac, and leaving the portion below the ligature still attached, or cutting it off. Besides, there is the alternative of leaving the truncated end of omentum in the sac, or of replacing it in the abdomen. By the exercise of due care, omental adhesions to the sac may be safely separated, whether recent or chronic.

If the omentum be cut off, there is great risk of bleeding from its cut vessels when it is replaced in the peritoneal cavity. Even after every precaution has been taken to secure the blood-vessels, cases in which omentum has been excised have proved fatal from internal hæmorrhage alone.

It has been assumed by some writers to be injudicious to tie a ligature around the omentum, on account of the untoward results which may ensue. But the reader should refer to the essay on Injuries of the Abdomen, where he will find the good results of this plan of treatment related by Mr. Pollock, as well as the mode of applying the ligature.

By the kindness of the editor, Mr. Holmes, we are able to give the result of the practice of removing diseased or superfluous omentum, after ligature, as performed at St. George's Hospital. Of twenty cases of hernia, in which the omentum was securely tied, a few died; but the notes of the after-death examination of them show the cause of death to have been, in all cases, independent of the ligature placed around the omentum. Of eleven cases in which the omentum was allowed to remain in the sac, many recovered, although abscess and sloughing of its tissue occurred in some of them.

[1] Relating to these cases, the reader may consult *A Treatise on Obstructed and Inflamed Hernia*, by Henry Stephens.

We are informed that in no single instance has any untoward symptom been excited by the ligature of the omentum; and that the truncated portion of omentum filling the orifice of the sac plugs it, and produces a permanent obstruction to the descent of a hernia, quite as completely as when the whole mass is left. The period occupied in the cicatrisation of the wound seemed also to be shorter in the cases in which the omentum was removed than in those in which it was not.

Cases of double hernia.—In patients suffering with a protrusion on both sides of the body, or in different regions, it is sometimes difficult to ascertain which hernia is strangulated. The surgeon must, of course, employ every means to arrive at a correct diagnosis before commencing the operation. But should he unfortunately have arrived at an erroneous conclusion, and having opened the sac of one hernia find no impediment to its reduction, nor indication of a strangulation, is he justified in cutting open the sac of the other? Certainly. And, as a precedent, we may refer to a case in which M. Dupuytren performed a double operation, and saved the life of the patient.

A man, aged 40, was the subject of double inguinal hernia. A surgeon with much difficulty reduced both tumours. Well-marked symptoms of strangulated bowel existed, although there was no tumour at either ring. M. Dupuytren opened the right inguinal canal first, because the patient complained of most pain when pressed on that side. The sac was empty. He next opened the left inguinal canal and found a hernial sac containing an entero-epiplocele. The orifice of the sac was very deep; it was cut; the bowel returned; and the patient recovered.[1]

Treatment of the case after the operation.—The immediate effect of the reduction of the hernia is usually the cessation of vomiting, especially if the bowel had not been strangulated a very long time, and neither peritonitis nor hiccough had existed before the operation. After the employment of chloroform, however, the sickness and nausea induced by the anæsthetic will sometimes continue, when the treatment must be modified accordingly.

Another most striking result of the replacement of the bowel in the peritoneal cavity is the rapid relief from pain across the mesogastrium.

It is manifest that no single plan of treatment, to the exclusion of every other one, can be urged as applicable to all cases of hernia, after the liberation of the bowel. As the disease occurs at every age, in every variety of constitution, and under individual peculiarities of the most diverse kind, so strangulation of the hernia may happen with the idiosyncrasies and opposite conditions of youth and senility, strength and decrepitude, health and disease, temperance and intemperance. It must, however, be carefully borne in mind, when treating a case of this kind, that we have to deal locally with an injured intestine, and a penetrating wound of the abdominal cavity; and that the constitutional powers of the patient are greatly reduced by continual vomiting, starvation, suffering, and alarm.

In some youthful, robust patients, the tendency to inflammatory action becomes, at an early period, strongly developed, whilst, on the contrary, in the aged and decrepit little disturbance may appear demanding interference.

The after-treatment has been conducted upon the most opposite principles. Surgeons of the highest eminence may be found amongst the advocates of the two methods, which may be briefly stated as follows:

In one class are those who administer purgative medicines almost immediately after the operation, and persist in their continuance 'until the canal is completely unloaded.' Calomel, extract of colocynth, sulphate of magnesia, and castor-oil, are given by the mouth, or aperient enemas injected into the rectum.

Another class, relying almost entirely upon the restorative powers of nature and the influence which repose exerts on the reparation of injured tissues, depends upon diet and, when required, opium.

In selecting one of these plans of treatment for adoption, we give the preference to the last, since it seems to be most suitable to the majority of the cases occurring in hospital practice. In many cases we have allowed the patient to recover without

[1] *Leçons orales*, edit. 1832, t. i. p. 583.

giving any medicine whatever; great care, however, being taken that a mild and farinaceous diet, with milk, be only sparingly taken.

This necessity for repose, writes Mr. Key, in an injured state of the bowel, it would be well to bear in mind, after the operation for strangulated hernia. The bowel is gorged by the strangulation, bruised by the taxis, as it is too often practised, or inflamed by long incarceration in the sac. An intestine in such a condition cannot but be injured by an early administration of purgatives, which irritate and inflame the bowel, or exhaust what little remains of vital energy. After the operation, some time for repose should be allowed before the bowel is called into action: the surgeon's anxiety to procure stools should yield to the evident necessity for time being allowed for the restoration of the natural powers of the injured bowel.[1]

Great advantage is sometimes derived from the effects of thirty drops of the tincture of opium, which may be given with a little brandy-and-water, or camphor-mixture, soon after the operation.

The bowels are often relieved spontaneously a few hours after the reduction of the hernia; but when they are obstinately inactive, the question arises of the necessity of giving aperient medicines. We have embraced abundant opportunities of comparing the advantages to be gained by the use of purgatives, and by abstaining entirely from their employment. We give the preference to the latter plan, but if the lower bowel becomes loaded, and any discomfort arises from accumulations therein, an enema of warm water, or gruel with common salt or a little castor-oil, or even sweet-oil, mixed with it, produces the desired result. Cases under our treatment have progressed favourably, and even the wound has healed, before the bowels have been relieved, and not the slightest trace of inconvenience occurred from the constipation.

When there is much tenderness on slight pressure on the abdomen, in the neighbourhood of the wound, the local application of leeches is of great service, and it may be repeated as often as required, but in relation to the powers and condition of the patient.

If acute peritonitis be developed, the treatment must be in accordance with the ordinary rules for the treatment of that disease.

Stimulants are often required soon after the operation, and should be given in small quantities. Indeed it is a rule which requires to be enforced, that all aliment must be given in very small quantities, and repeated at short intervals.

If thirst be distressing, pieces of ice placed in the mouth afford great comfort.

Treatment of the wound.—The structures which have been cut and disturbed by the cutting operation should be placed in relation to each other, and the divided edges of the integuments brought together by sutures. The number required may be left to the discretion of the operator, but no more need be used than sufficient to keep the upper two-thirds of the wound united. For it is always advantageous to leave an opening at the lowest end to allow of the escape of blood and discharges. A piece of wetted or dry lint may be laid over the incision, and a pad of folded lint is adjusted over it with a bandage by some surgeons. However, a bandage is not required in every case, nor is it on any account essential.

If, during the subsequent progress of the case, the connective tissue in the wound, the omentum, or the hernial sac should inflame, the appearance of the integument soon betokens that union by adhesion is hopeless. In that case the lowermost sutures, or all of them, must be removed, and the treatment to be adopted need not differ from that commonly employed in every inflamed, suppurating, or sloughing wound. The grand point is to keep a channel open for the free escape of the discharges.

The prognosis of a case of strangulated hernia.—Reflection upon the facts already described will enable the surgeon to form a very nearly accurate prognosis of a case of strangulated hernia. But in order to concentrate the attention of surgeons upon those incidents which more especially cause a fatal termination, we must briefly

[1] *Guy's Hospital Reports*, 1842, vol. vii. p. 263.

recapitulate the most important morbid conditions which call for special observation.

1. The condition of the tissues of the herniated viscera, and especially of the intestine. Their morbid state is too frequently produced by violence in the use of the taxis, by long-continued constriction, or very tight strangulation of short duration. In such cases, then, the prognosis is usually unfavourable on account of the destruction of the portion of the bowel injured, or of its inability to repair the damage inflicted upon it.

2. The morbid state of the peritonæum, visceral and parietal, and of the tissues of that portion of the track of the alimentary canal between the stomach and the hernia. The existence of peritonitis antecedent to the liberation of the bowel cannot be regarded in any other light than as a symptom of grave significance. Associated with it, the alimentary canal above the hernia is usually greatly distended, and its contractile fibres appear to lose their function. These circumstances add to the unfavourable prospects, and lessen the chances of recovery in a very marked degree.

3. The impaired functions of the nervous system. Many patients sink away in the stage of prostration alone. This state of the nervous system is induced by long-continued vomiting, starvation, pain, suffering, exposure, neglect, journeying, purgative medicines, some medicated enemas, the hot or warm bath in some instances, and other measures supposed to facilitate the reduction of the hernia by the taxis. When great prostration, therefore, precedes the reduction of the hernia, it must be regarded as a most unfavourable indication.

4. Neither should we overlook the chronically morbid states of the viscera of the thorax and abdomen, irrespective of the hernia, so commonly existing in the class of persons admitted into our hospitals. Over the influence of these conditions, however, we can exert but little control, although they form an important element in prognosticating the issue of any case.

5. All these conditions are also influenced by the age of the patient, social habits, general cachexia, and individual idiosyncrasies—features in a case to which due attention must be given.

Now the lesson that we learn from the study of those morbid states which bring about a fatal termination is this: To return the herniated viscus into the abdomen as quickly as possible; to accomplish this with the utmost delicacy of manipulation consistent with the requirements of the case; to distinguish carefully between those cases in which no delay is admissible in liberating the bowel without the loss of a moment, and those in which some means are justifiably employed to assist the taxis. By acting thus energetically upon sound principles; by remaining at the bed-side of the patient, or at least not leaving the case until the risk of danger is averted by reducing the intestine, the surgeon may hope to rescue from death a very large majority of the cases of strangulated hernia.

The high mortality arising from strangulated hernia is an opprobrium upon the medical art which cannot be removed by any amount of skill or dexterity displayed by the operating surgeon. The risk of the operation, the mode of its performance, and the subsequent treatment of the case, are merely secondary considerations when compared with the treatment to which the patient is subjected before the operator is called upon to perform his part. All matters relating to the operation only have, perhaps, reached perfection; but it would really appear, from the condition in which patients are sent into the hospitals to be operated upon, that the greatest amount of ignorance prevails of the principles upon which an irreducible hernia should be treated.

HERNIA.

PART II.

SPECIAL KINDS OF HERNIA.

THE following classification of abdominal ruptures is arranged with regard to the anatomical divisions of the abdomen in which they appear :

I. In the EPIGASTRIUM
1. Diaphragmatic.
2. Epigastric.

II. In the MESOGASTRIUM
1. Ventral (also in other regions).
2. Umbilical.
3. Lumbar.

III. In the HYPOGASTRIUM
A 1. Above Poupart's ligament; inguino-scrotal; or labial.
B 2. Below Poupart's ligament; femoral.
C 3. Through the apertures of the pelvis; in front—beneath the ramus of the pubes, obturator.
4. In front—beneath the arch of the pubes, perineal.
5. Pudendal.
6. Vaginal.
7. Behind—through the ischiatic notch, ischiatic.

HERNIÆ IN THE EPIGASTRIC REGION.

Diaphragmatic hernia.—Of these cases there are three kinds :[1] first, that in which a part of the diaphragm muscle becomes stretched in consequence of a loss of tone, and is pressed up into the thoracic cavity by the contents of the abdomen; secondly, that in which, in consequence of congenital defect, some of the viscera pass through the aperture into the thorax; and, thirdly, when some of the abdominal viscera pass into the chest through the natural apertures in the diaphragm, which have become enlarged.

Epigastric hernia escapes in the angle bounded by the cartilages of the first false ribs, the apex of which corresponds to the appendix of the xiphoid cartilage. M. Malgaigne has seen an infant with a tumour in this region which swelled up every time any effort was made with the abdominal muscles. The sac of this hernia is generally more movable than that of an umbilical, and the mouth through which the hernia enters it is usually large. The reduction of the protrusion is therefore easily effected. A suitable bandage is required to prevent the escape of the hernia, which sometimes consists of a portion of the stomach, or arch of the colon and omentum.

[1] Exclusive of cases in which the abdominal viscera pass into the chest through a laceration in the diaphragm. Such cases are treated of under INJURIES OF THE ABDOMEN.

Hernia in the Mesogastric Region.

Ventral hernia.—Of this hernia there are two kinds : first, those which occur at the linea alba ; and, secondly, those which pass through other parts of the parietes, except the so-called rings.

Those of the first kind usually escape in the linea alba between the umbilicus and the pubes. They are produced as the consequence of general relaxation and stretching of the fibrous tissue in the middle line of the abdominal walls after they have been greatly distended during pregnancy or ascites. We have seen hernia consecutive to an abscess in which the pus had made its way through at the linea alba. This kind of hernia is more common than the second, which escapes through any part of the anterior or lateral walls.

The usual indications of a rupture accompany these kinds also ; the chief risk of an error of diagnosis arises when chronic abscesses, cysts, or fatty growths exist in the parietes. If the hernia be reducible, the surgeon would not be likely to fall into error ; and if not, the history of the case, with a careful manipulative examination, will enable him to form an accurate diagnosis.

Umbilical hernia.—By this term we understand that kind of rupture which escapes from the abdominal cavity, either through the umbilical ring in the fœtus, or by an aperture formed at a later period of life in consequence of a separation of the fibres of the linea alba in the umbilical region. (See fig. 167, p. 817, in which a small one is delineated.)

The synonyms are, exomphalos, omphalocele, or, in common language, ruptured navel.

It is developed at all periods of life, and in both sexes. Most commonly observed in infancy, it forms a protrusion either before or soon after the separation of the umbilical cord. In youth it is rarely developed, provided that the umbilical aperture has been once well closed. As years advance, it is more frequent, especially in females, and particularly so in persons disposed to obesity.

The hernial sac is always an acquired formation in this rupture ; that is to say, there is not any peritoneal extension at the umbilical ring, in fœtal life, analogous to the inguinal vaginal process of the peritonæum. Nevertheless, writers have been long accustomed to divide this hernia into the congenital variety, or that which is so common in infants ; and the acquired, or that variety which is developed in after-life.

In infants the protruding viscus pushes before it that portion of the parietal peritonæum lying immediately behind the aperture in the linea alba, through which the umbilical vessels enter the abdominal cavity. The hernial sac is thus formed before the closure of the ring is effected, and may pass into the connective tissue of the cord itself, before that structure has separated. We have seen such a case in which the integuments covering the sac sloughed. Rather later, after the separation of the cord, the hernial sac may be protruded in consequence of the umbilical aperture remaining imperfectly closed when it is covered only by the integuments. In youth, a rupture may be developed by escaping through a partially closed ring, which, by continued pressure, it dilates, unless precautions be taken to prevent it. And, in adult life, the fibres of the linea alba become separated by stretching or yielding to the pressure from within, and the rupture escapes at the site of the once closed ring, or in its immediate vicinity. The coverings of the hernial sac are generally very thin, and often inseparably united together. They consist of the integuments ; some fat, which, however, is not often in proportion to the thickness of the layer over the other regions of the abdomen ; and the delicate internal abdominal fascia. The body of the sac is usually very delicate, but it is rather stronger near and at its orifice, around which part the tissues outside of it form a very firm, resisting, unyielding band. The mouth of the sac is often large in proportion to the bulk of the protrusion. The relation which it bears to the tumour when the protrusion is large should be carefully studied. As the bulk of the hernia increases, it does not

spread equally around the ventral aperture upon the anterior surface of the abdominal walls, but it descends towards the symphysis pubis. In some cases it happens that the transverse diameter of the tumour is greater than the vertical; and occasionally its configuration is so pyriform that the tumour seems to be suspended by a peduncle or stalk. At other times its base is nearly as large as its body; and, again, we may see an almost sessile tumour which, when elevated, is attached by a small stalk, thus resembling a mushroom in shape.

Various organs of the abdomen are found in the sac of an umbilical hernia; very frequently the omentum, the stomach,[1] portions of the small intestines and of the large. When the disease has been neglected, we have seen nearly the whole of the intestinal canal in the sac enveloped by omentum. The last-mentioned organ sometimes becomes firmly united to the sac; and when bands or septa are thus produced within it, the intestines may become entangled by them. The omentum likewise becomes hard and contracted, forming masses within the sac which sometimes give rise to difficulty in diagnosis.

This rupture begins by forming a small soft projecting ovoid tumour at the navel. Gentle pressure with the finger pushes something into the abdomen, and a small hole is then felt, with very sharp, rigid edges. Directly the finger is removed, the skin either remains relaxed or flabby in the fossa of the navel, or it is slowly projected forwards, and reappears in the same bold relief. If the progress of the disease be not arrested, the protruding viscus descends lower and lower, so that the broadest part of the tumour lies below the mouth of the sac. A curious example of congenital umbilical hernia, coupled with malformation, was shown by Dr. Gibb at the Pathological Society, and in the same volume of the 'Transactions' there is a description of a case of triple umbilical hernia which contained portions of the stomach, duodenum, jejunum, ileum, omentum, and ductus communis choledochus.[2]

Treatment when reducible.—Should there be any disposition to a protrusion at birth, or soon after, the simple application of a bandage is not merely palliative, but materially tends to the cure of the case. In infancy, after the separation of the cord, the protrusion may be prevented by fixing a piece of cork over the umbilical ring. It should be circular, about one inch in diameter, slightly convex on both surfaces, and covered with soft leather. With adhesive plaister to retain it in its proper place, and a bandage encircling the abdomen, but not violently compressing it, this plan is sure to effect a cure. When the protrusion occurs in an adult, a suitable truss or bandage must be employed, with a view to prevent the dilatation of the sac and the increase of the tumour. If a large irreducible hernia has to be treated, a suitable appliance is required.

The radical cure of this hernia has been successfully effected by an operation performed by Mr. Barwell, on three patients, at the respective ages of six months, fifteen months, and eight years.[3] It is, however, open to further inquiry, how far any cutting operation is justifiable in infancy, as so large a proportion of cases are curable by bandages or trusses. Mr. H. Lee states that he has cured cases by inserting needles through the sac, after carefully reducing its contents, and keeping the surfaces in close contact by twisting a ligature over them. Mr. Wood makes use of rectangular pins and the wire suture.

Mr. C. Heath, having been called on to operate in a case of strangulated umbilical entero-epiplocele, after having returned the bowel, dissected the sac from its attachments; and having passed a ligature through its base and the omentum, cut them off. The patient recovered; and when the report was given to the Pathological Society there was not then any hernial protrusion.[4] But we are at a loss to understand how the opening in the linea alba was closed by these means; and therefore until it can be shown that this has been accomplished, we should not recommend the adoption of this measure.

[1] A very interesting case is related by Mr. Moore, in the *Med.-Chir. Trans.* vol. xlvi. p. 181.

[2] *Trans. of the Pathological Society of London*, vol. vii. pp. 216, 220.

[3] *The Lancet*, 1861, vol. ii. pp. 419, &c.

[4] *Transactions of the Pathological Society*, vol. x. p. 131.

Cases of umbilical hernia offer remarkably well-marked examples of that condition termed obstruction from accumulation of stercoraceous matter, and patients are constantly subject to severe constitutional disturbance arising from this cause alone, and not from positive strangulation of the bowel. We should not, therefore, be in a great hurry to operate in these cases; for after a free administration of aperient enemas, the bowel becomes unloaded of its contents, and evacuations from the alimentary canal are obtained.

The operation.—An incision should be made in the mesian line of the body, commencing about two or three inches above the upper border of the mouth of the sac, and continued downwards upon the sac as far as may be requisite. The smaller the opening by which the surgeon can remove the impediment to the reduction of the hernia, or liberate the bowel from constriction, the better; and when it can be accomplished without opening the peritoneal sac, it is desirable to do so. Great caution is necessary whilst cutting the different coverings of the sac; and should it be necessary to cut the tissues forming its orifice, the incision should extend upwards in the same line as the first.

Hernia in the loins.—Lumbar hernia has been described by several surgeons. These protrusions arise after contusions of this region, or perhaps after lacerations of the abdominal muscles in the part, as well as from relaxation of the tissues. In the third 'Bulletin des Travaux de la Société de Médicine de Marseille,' Dr. Chapplain [1] relates the case of a man, aged 60, who, after being squeezed between a wall and a carriage, found in his loin a tumour between the crest of the ilium and the last rib. It appeared at first like a chronic abscess, but the presence of intestine was easily ascertained. Mr. Kingdon has seen a case of this kind. The bowel protruded just above the crest of the ilium at its highest point, about three inches from the spine, just where the quadratus lumborum and abdominal muscles meet. The man was 54 years old, tall and thin. He suffered with hæmoptysis and emphysema of the lungs.

Herniæ in the Hypogastric Region.

Inguinal hernia is the most common kind. The statistics of the City of London Truss Society prove this; for rather more than two-thirds of the total number of applicants of both sexes for trusses to support every description of hernia, were afflicted with inguinal ruptures of one kind or the other.[2]

Of inguinal hernia the following varieties are described: the oblique or external, and the direct or internal. The terms external and internal have reference to the course taken by the internal epigastric artery in relation to the orifice of the hernial sac. In the oblique kind, the mouth of the sac is situated to the outer or external side of this artery; in the direct, this important part of the sac is placed to the inner side of the same vessel.

There are also varieties of the oblique kind named according to the situation of

[1] *L'Union médicale*, 1862, vol. i. p. 157.

[2] Table B.—*Showing the proportions between inguinal and femoral hernia in both sexes at different ages.* (Constructed from Kingdon's tables, 1860-61.)

Ages	Inguinal		Femoral	
	Male	Female	Male	Female
1 to 20	2,435	249	23	38
20 to 40	2,954	322	139	432
40 and upwards . .	2,154	128	144	278
	7,543	699	306	748

This table shows—1. That inguinal hernia is most common. 2. That in females femoral and inguinal herniæ occur in about equal proportions. 3. That femoral hernia in the male is the least common of these kinds.

the protrusion; thus the tumour is called a 'bubonocele' when the hernia has passed the internal inguinal ring, but has not protruded at the external, when, in fact, it is retained in any part of the inguinal canal. It is called 'scrotal hernia, or oscheocele,' when it has passed through the external abdominal ring, and is therefore in the scrotum.

We propose the following anatomical classification of the varieties of oblique inguinal hernia.

1. Into the vaginal process of the peritonæum (the congenital hernia of Haller, and subsequent writers).
2. Into the funicular portion of the vaginal process of the peritonæum.
3. Scrotal, the sac being thrust into the tissues of the scrotum.

Of inguinal hernia in the male.—This species escapes from the abdomen, *above* Poupart's ligament, through the internal and external inguinal apertures or abdominal rings. There are two varieties, the *oblique* and the *direct.*

Oblique inguinal hernia, having passed through the internal inguinal ring, lies in

FIG. 163.—Double Inguinal Hernia.

On the man's right side the protrusion has passed through the inguinal canal, and is just entering the scrotum. On the left side it is called 'bubonocele.' The outline of Poupart's ligament, below the swelling produced by the protrusion, is distinct.

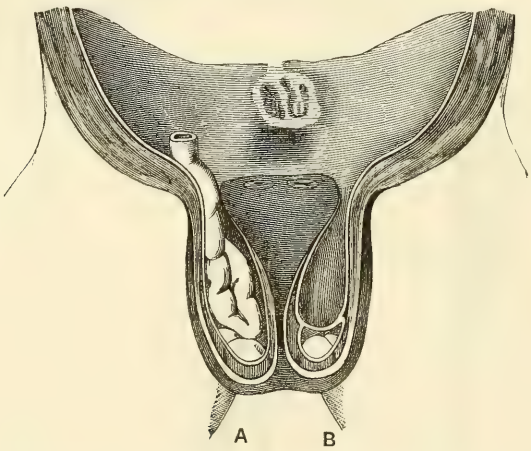
the inguinal canal. Pursuing the oblique direction of this canal, it points at the external inguinal ring, emerges and enters the scrotum, into which it descends. The mouth of the hernial sac is situated to the outer side of the internal epigastric artery, whilst its neck and body are usually in front of the structures composing the spermatic cord. But in rare cases these organs are divided; sometimes the blood-vessels pass over the tumour, the vas deferens behind it, and *vice versâ*; or they are attached to the sides of the tumour. The relative positions of the hernial tumour and testicle differ. The variable site of this organ depends upon congenital defect, and hence in some cases the testis cannot be distinguished from the tumour produced by the hernia. However, in the majority of cases, the testicle is situated at the posterior and inferior region of the scrotum; more rarely, it may be detected at the front of the fundus of the tumour. An endeavour should always be made to ascertain the site of this organ, in every case of inguinal hernia, and under all circumstances.

The coverings of the sac of an oblique inguinal hernia are formed by the tissues of the region in which it lies. To expose the sac of a bubonocele, it is necessary to divide the integuments of the groin, the aponeurosis of the external abdominal

oblique muscle, and the internal spermatic fascia. Some of the fibres of the free edges of the internal oblique and transversalis muscles are observable along its upper border, and some fibres of the cremaster muscle skirt its lower edge. To reach the sac of a scrotal hernia, we must divide the integuments of the scrotum, including the dartos, the fibres of the cremaster muscle, often strongly developed, and the internal spermatic fascia. This last-named fascia is the delicate membranous extension of the internal abdominal fascia along the spermatic cord.

The mode of development of the sac of an oblique inguinal hernia differs essentially in respect of the age of the individual in whom it takes place. Thus in infancy, youth, and early manhood, the disease is usually dependent for its existence upon a congenital imperfection. To this circumstance is due the persistence of a serous canal, or sheath, in direct communication with the peritoneal cavity, through the mouth of which a portion of omentum or of bowel may enter, and thus form a hernia at any period of life. On the contrary, in adult life, the hernial sac is a secondary structure, a distinctly new formation. Its development is slow; its progressive stages may be traced; and, although a prolongation of the parietal peritonæum, its existence is due to a morbid action, which allows displacement or stretching of this serous membrane.

Fig. 164.



Hernia into the vaginal process of the peritonæum.—The development of these two very different kinds of sacs has been already described (see pp. 754, 757), in considering the causes of hernia; and at the same place the reader will find the reasons which induce the author to prefer the designations of 'hernia into the vaginal process' and 'into the funicular portion,' to those of 'congenital' and 'infantile,' formerly in use. There also the natural varieties found in the condition of this process are described.

Under abnormal conditions, the following states of this sheath are found:—

1. The whole length of the canal remains open.

2. The entire canal may remain open, and an annular constriction of its walls take place between the external abdominal ring and testis.

3. The tunica vaginalis propria testis is perfected, becoming now a closed sac, but a canal exists as far as the testis.

4. The abdominal orifice is completely closed, but a canal below this exists.

The diagrams are intended to illustrate the congenital conditions of the vaginal process of the peritonæum. The serous canal is represented cut open vertically and viewed from the front.

Fig. 164, A. The tubular process of the peritonæum is open from the general peritoneal cavity to the fundus of the scrotum, at which part the testis is situated. This gland, however, may be fixed at different sites.

Drawings representing this imperfection may be found in the following works:

Camper, 'Icones Herniarum,' tab. x. fig. 3; Hunter (John), in 'Medical Comm.' pt. I. chap. ix.; and in Palmer's edit. of the 'Works of J. Hunter,' plates xxv. xxvi. For numerous references to books on this subject, refer to 'A Treatise on Ruptures,' by W. Lawrence, F.R.S., 5th edit. 1838, p. 564.

The variety of hernia developed in consequence of this imperfection is the hernia congenita of Haller and subsequent authors.

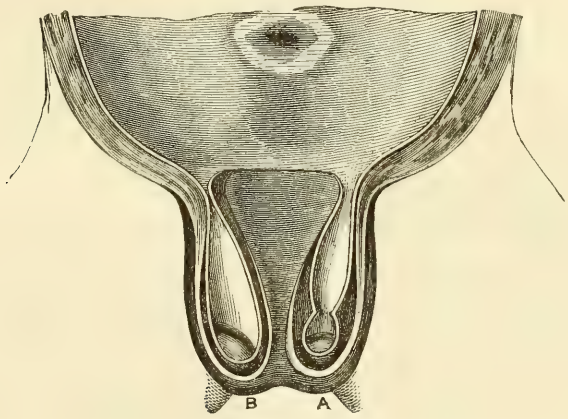
Fig. 165, A. In this figure the vaginal process of the peritonæum is open, as in the last imperfection; but a contraction has taken place at the point above the testis.

This imperfection is demonstrated by a preparation in the Museum at Guy's Hospital, No. 2368; and a drawing from a case reported by Sir Charles Bell, in the 'London Medical Gazette,' 1828, vol. i. p. 485.

Examples of hernia into a vaginal process of this kind are noticed by Scarpa; see Wishart's translation, 'Memoir,' ii. § 10. A drawing of a similar case may be seen in the work by Sir Astley Cooper on 'Abdominal Hernia,' the 2nd edition by Mr. Key, pl. II. fig. 2. Another is related by Mr. Lawrence in his work on 'Ruptures,' as before, p. 574; and I have myself operated upon cases of this kind in young men. A large hernial sac with this remarkable condition may be examined in the Museum of the Royal College of Surgeons of England, No. 1343.

Fig. 164, B. This diagram shows the division of the vaginal process of the

Fig. 165.



peritonæum, into the inferior testicular vaginal process; and the superior funicular vaginal process, at the ventral end of which a communication with the abdomen remains, as on the other side.

This imperfection is delineated by Camper. In the work 'Icones Herniarum,' folio, 1801, plate x., he contrasts it with that one represented in fig. 164, A. The drawing was made from the dissection of an infant, in 1759. Seiler also gives a figure to illustrate a rather more contracted state of this part of the vaginal process, in a work entitled 'Obs. de Testiculorum ex abdomine in scrotum descensu, &c.' More recently, M. Malgaigne has described the frequency of hernia in association with this imperfection, 'Leçons clin. sur les Hernies,' Paris, 1841; and in 'L'Union médicale,' 1854.

Examples of hernia into the funicular portion of the vaginal process of the peritonæum occur very commonly in children, and a preparation of a hernial sac, originating with this defect, is preserved in the Museum of the Royal College of Surgeons, No. 1328.

Fig. 165, B. In this diagram the vaginal process is represented as a tube passing down in front of the spermatic cord and testis. The ventral orifice has been closed above or nearly so.

This is the condition of the vaginal process of the peritonæum described by Mr. Hey, in which he 'found that the tunica vaginalis was continued up to the abdominal ring' ('Practical Obs. in Surgery,' 3rd edit. 8vo. 1814, p. 227).

I suspect that it is this imperfection of which preparations exist in museums, described as 'a congenital hernial sac with the mouth obliterated,' when unaccompanied with a history that the man from whom it was removed had ever been ruptured.

Associated with congenital persistence of the vaginal process of the peritonæum, the testicle of the same side as that on which the defect occurs frequently occupies an abnormal situation.

When in its normal site at the lower part of the scrotum, it cannot always be distinguished from the hernial protrusion which occupies the same serous sac as this organ and overlies it. But, although this region should contain a hernial tumour, the testis may not have reached the scrotum at all.

The situations in which it is then found are as follows :

1. Within the abdomen ; the vaginal process extending into the inguinal canal, but not reaching further than just through the external abdominal ring, or into the upper part of the scrotum.

2. Fixed in the inguinal canal out of the reach of manipulation ; whilst the serous canal, passing into the scrotum, forms a sac for the reception of a hernia.

3. Immediately outside the external abdominal ring at the upper part of the scrotum ; in which state, when a hernia descends, it passes in front of this organ into the scrotum, even as low as its fundus.

4. When the testis is in the perinæum. A defective development of one or even both sides of the scrotum is associated with the cases of deformity above described which may lead the surgeon to discover an abnormal position of the testis ; a fact of great importance in the treatment of these cases of hernia.

Tabular view of the abnormal conditions of the vaginal process of the peritonæum, deviations from the normal situation of the testis, and the relative position of the hernia.

Hernia into the vaginal process of the peritonæum :

1. The vaginal process continuing open and common to the cord and testis. (Fig. 164, A.)

The testis may be situated—

a, in its normal site at the fundus of the scrotum ;
b, just outside the external abdominal ring, or between its pillars ;
c, within the inguinal canal ;
d, within the abdomen.

N.B. In *a*, *b*, *c*, the hernia is generally in contact with the testis ; in *d*, it is not.

2. The vaginal coverings of the cord and testis communicating by an aperture.
The testis in the scrotum.
N.B. The hernia may or may not pass through this aperture, and is therefore sometimes but not always in contact with the testis. (Fig. 165, A.)

3. The vaginal covering of the cord only being open. (Fig. 164, B.)
The testis in the scrotum.
N.B. The hernia is never in contact with the testis.

APPENDIX.—*Additional sacs, or prolongations and extensions of the vaginal process within the abdominal walls.*

Concurrent with these instances of malplaced testis are some of those complicated cases of hernia which arise from varieties in the configuration and anatomical disposition of the hernial sac. In a majority of the cases in which the hernial sac follows any very unusual direction, the hernia is found to occupy the same sheath as the testis, or a portion of that sheath—a sufficient proof of the precise nature of the hernia and of the cause of its development, if any be required. Several cases are recorded in which a sort of second sac or offset from the vaginal process of the peritonæum extended between the structures composing the abdominal walls.[1] Hence the terms

[1] *Guy's Hospital Reports*, 1861, p. 270.

'intraparietal,' 'ascending, or intermuscular,' and 'interstitial,' have been applied to this variety of hernial sac. Belonging also to this category are the cases termed 'hernie en bissac' by French writers. These cases form two classes :

1st. Those in which the sac extends into the anterior abdominal walls.

2nd. Those in which it extends into the inferior walls.

In the first class, the sac extends upwards from the inguinal canal in front of the internal abdominal fascia, and behind the aponeurosis of the external abdominal oblique muscle. It may take a course directly upwards; outwards, towards the crest of the ilium; or inwards, towards the rectus muscle and umbilicus.

If the sac has passed through the external abdominal ring and cannot enter the scrotum, it may ascend in *front* of the aponeurosis of the external abdominal oblique muscle, lying between it and the integuments; and when the hernia protrudes, it forms a tumour in the groin above and parallel with Poupart's ligament. An example of this rare variety is quoted by Scarpa,[1] and another case has been recorded by Dr. Fano.[2]

In the second class, the sac extends into the iliac fossa and rests upon the iliacus muscle, between the internal abdominal fascia and peritonæum; or directing itself inwards, it passes behind the horizontal ramus of the pubes, and reaches the side and front of the urinary bladder.[3]

Hernia into the funicular portion of the vaginal process of the peritonæum.—When the surgeons of the last century discovered that a hernia could pass into the vaginal process of the peritonæum, and there lie in contact with the testicle, they appear to have been content with this fact, and, without further research, to have assumed this variety to be the only form of hernia dependent for its origin upon non-closure of the ventral orifice of this canal, or defective obliteration of the funicular part of the vaginal process of the peritonæum. Thus many writers acknowledge the fact that an infant may be the subject of a scrotal hernia, and, after detailing such a case, they add, 'but not congenital'; implying by that expression simply the anatomical fact that the hernia is in a distinct sac, and thereby separated from the testis, in the same manner as it occurs in the adult. The term suggested in this essay precludes an erroneous view of those varieties of hernia which originate in congenital defect of the coverings of the testis and spermatic cord, and renders the disease in the infant and in youth much more easy of comprehension.

The reader should recall to mind the previous statements relating to the descent of the testicle, and the development of the tunica vaginalis propria testis out of the inferior termination of the vaginal process of the peritonæum. For surely there cannot be a tunica vaginalis propria testis developed so long as a canal exists along which a hernia may descend and touch the testis. Herein consists the deficiency; in this anatomical fact lies the defect. But when the testis is enveloped by the two layers of the serous membrane, the visceral and parietal, whereby the cavity of the tunica vaginalis testis is formed, in its own proper vaginal sheath, and is entirely shut off from every protruding viscus, there may yet remain the funicular portion of the vaginal process of the peritonæum communicating with the abdomen at the internal abdominal ring. Into this canal, termed the tunica vaginalis propria funiculi, a hernia may protrude, and the canal thus becomes converted into a hernial sac; quite as much 'congenital,' too, as the variety ordinarily characterised by that term, for it is dependent upon a congenital defect, viz. the non-closure of the abdominal orifice of the canal, and its continuation in front of the spermatic cord as far as the testis and its vaginal sheath. This variety is now distinguished as hernia into the funicular portion of the vaginal process of the peritonæum.

In the new-born infant, or at a later period, some weeks or months after birth, it is not at all uncommon to see males with a hernial protrusion occupying the

[1] *Treatise on Hernia*, translated by Wishart, 1814; 8vo. p. 171.

[2] *L'Union médicale*, December 1861.

[3] Cases by Dr. Parise, in *Mém. de la Soc. de Chir. de Paris*, 1851; *Mém. sur deux variétés nouvelles de Hernies.*

inguinal canal and scrotum, but entirely separated from the testis, which is normally situated, at the fundus of the scrotum.

M. Malgaigne was, I believe, the first surgeon to notice this variety of hernia, and to point out its origin, anatomical relations, and distinctive features. It is exceedingly common. Carefully instituted examinations lead us to conclude that it is nearly as frequently met with as the ordinary variety last described; but, from the fact of its having been confused with the scrotal hernia of the adult, very little attention has been bestowed upon it. The diminutive size of the testis has also led to its relative situation, as regards the hernia, being wholly overlooked and neglected; for cases which we have ourselves examined have generally been regarded as of the ordinary kind, termed 'congenital,' and not worthy of further consideration. In the earlier periods of life, the distinction is not, perhaps, of primary importance; but the recognition of this variety in youth and adult life becomes a necessity of great moment in some instances, not only in reference to correct diagnosis, but also with respect to the judicious treatment of the case.

In these cases, the hernia being enveloped by a peritoneal sac, the pathologist must admit one of two explanations of its development: either that the parietal peritonæum of the abdomen was suddenly pushed downwards before the hernia to form its sac; or that a serous canal existed continuous with the peritoneal cavity, which became converted into the hernial sac. The last explanation, being strictly in accordance with anatomical facts, appears to me to be the one which the morbid anatomist will adopt.

The congenital patulence of the funicular portion only of the vaginal process of the peritonæum is capable of proof by anatomical examination, and there is no more reason to question its remaining so during the later periods of life, than to dispute the fact of the occasional unobliterated state of the entire length of the vaginal process to the fundus of the scrotum in adult life. We are able to adduce abundant facts to prove the development of hernia in such cases, if space permitted.

In advancing adult life, the orifice of the hernial sac still maintains its original relations to the internal abdominal ring, and especially its depth. Under these circumstances, a hernia having existed many years, the abdominal rings are not approximated, but remain widely separated. A man, forty-five years old, was operated upon by myself on account of strangulated oblique inguino scrotal hernia, with which he had been afflicted since boyhood. This was the first time he had found any difficulty in returning the protrusion. The orifice and neck of the sac were deeply seated; that is, the index-finger was passed along the inguinal canal to reach the abdominal orifice of the sac. It did not require division, but was sufficiently large to allow of the reduction of the hernia after the sac had been opened, and a large quantity of serum had escaped. His case terminated successfully. The testis was at the fundus of the scrotum, and separated from the contents of the hernial sac.

The next question relates to the frequency of these varieties of hernia into the vaginal process of the peritonæum.

After making inquiry of patients afflicted with inguino-scrotal hernia for many years, we were much surprised to find that so many of them stated that the protrusion occurred suddenly, and was first observed when the dimensions of the scrotum were increased by the presence of the hernia. Another circumstance also attracted attention. Robust, healthy, and well-developed men, of middle age, asserted that the rupture first descended when they were about twenty years old—a circumstance nowhere specially alluded to; but it appears to be a very common occurrence. When discussing this matter with friends, and stating this fact, they have suggested that working-men might not be very accurate in their statements, and that, being habitually thoughtless of their persons, no dependence could be placed upon their assertions. This objection has had its due consideration and weight in our inquiries, and we have, therefore, only referred to recent cases, or accepted the accounts afforded by those patients who seem to possess a fair average intelligence and might be presumed to give reliable information concerning the subject of inquiry. During the

two years 1859 and 1860, forty-four patients, suffering more or less from inguinal hernia, were admitted into the wards of Guy's Hospital. Among them were twenty-six cases of hernia into the vaginal process of the peritonæum; and of these, twelve had the testis and hernia in contact (the hernia congenita of Haller), whilst in the remaining fourteen the hernia occupied the funicular portion of the canal, and was separate from the testis. In several patients the hernia was developed suddenly, and reached the scrotum at once, the first time it was observed, even in adult life, the men being robust, and well-developed. The respective ages of the patients, at the time they came under examination, varied between fourteen months and forty-seven years.

Pott wrote, nearly a hundred years since: 'Ruptures attended with that particular circumstance which brings them under the description mentioned in the title, are said to be very rare; but from what I have observed, both in the living and in the dead, I am inclined to believe that they happen much oftener to adults than they are suspected to do.' [1]

To demonstrate, perhaps even more satisfactorily, that a large proportion of the cases of inguinal hernia is developed at a very early period of life, we may refer to the Reports of the City of London Truss Society, so industriously drawn up by Mr. Kingdon.

The total number of males applying at the Society during the years 1860 and 1861, whose ages were ascertained at the time the hernia was first observed, amounted to 7,543; of these, 3,963, or 383 more than half, had reached only thirty years of age. Thus it appears certain that inguinal hernia is developed very frequently before thirty years of age.

This statement, which may be accepted as correct, is fully supported by reference to the table I have arranged from the Report of the City of London Truss Society (see table, p. 748). By this it appears that inguinal hernia occurs very frequently during the first twelve months after birth. This happens in consequence of the congenital persistence of the canal of the vaginal process of the peritonæum. Its frequency then diminishes to puberty, after which period the cases rapidly increase to the completion of thirty years of age.

Taking periods of ten years, or decades, the frequency of inguinal hernia at different ages is well seen (see table, p. 796). It is remarkable that the first decade contains the largest number of cases, and next the third or that between twenty and thirty years of age. From this period of life the cases decrease in a rapid ratio.

Hour-glass-shaped contraction of the sac of oblique inguinal hernia.—An uncommon peculiarity in the conformation of the sac itself of an oblique inguinal hernia occurs in consequence of a narrowing of its walls at a point corresponding with the site of the external abdominal ring, or a little below that point in the scrotum between the testis and that aperture. When a hernia fills the sac, it may become strangulated by this constriction. The outline of the hernial tumour, as well as that of the sac, exactly resembles the shape of the ordinary hour-glass: hence the name given to it. It is always associated with the congenitally open state of the vaginal process of the peritonæum. The result of the imperfect closure of this sheath at that part where union of its walls normally takes place is to give rise to the formation of a ring or circular constriction within this process of the peritonæum at the point where the tunica vaginalis propria testis and tunica vaginalis propria funiculi meet together. Instead of the upper division of this canal being closed, and the two divisions, by this means, rendered distinct from each other, they communicate freely. The result is, that a hernia passes through the abdominal orifice of the funicular portion of the canal, traverses it, and then passes through the constriction into the cavity of the tunica vaginalis propria testis, which gland it touches. Instances of this

[1] *An Account of a particular kind of Rupture, &c., viz. that in which the Intestine or Omentum is found in the same cavity and in contact with the Testicle,* by P. Pott. Lond. 1765, 2nd edit. p. 5.

constricted condition of the sac of an oblique inguinal hernia are related by Pott,[1] Wrisberg, Le Cat, Scarpa,[2] Pelletan, Sir A. Cooper, and Mr. Lawrence.

Case.—A labourer, 29 years old, was brought into Guy's Hospital in September 1858, in a state of great prostration, and having a rupture in the left side of the scrotum. There had never been any tumour noticed until seventy-eight hours before admission. All observers were struck with the small size of the neck of the tumour, its pear-shaped form, thus closely resembling the outline of a hydrocele, and the seeming absence of the left testis. The external abdominal ring was distinctly recognisable, and I could pass my fingers through it, but I could not make out distinctly the spermatic cord. On palpation a very audible gurgling sound was produced in that division of the swelling between the internal ring and the upper part of the scrotum, the integuments of which were red, tense, and shining. The whole tumour was divisible into a superior division and an inferior. This last, which was the largest, remained unaltered by manipulation, was firm, and resisted pressure, although slightly elastic, and was very painful when compressed. The upper division was soft, and the swelling entirely disappeared when slight pressure was applied; but it was reproduced by the contraction of the abdominal muscles, or by pressure on the abdomen above the internal ring. All the symptoms of strangulated intestine being strongly marked, and considering that the liberation of the hernia was imperative, I administered chloroform; and finding, when the man was fully under its influence, that I was still unable to reduce the protrusion, I determined to operate at once. An incision of the integuments, four inches long, was made, the direction of which was parallel with the long axis of the tumour, and the centre corresponded with the site of the external abdominal ring. This aperture, although seen, was not sharply defined. I could now pass my finger upwards on the outside of the hernial sac to the internal ring, and trace its boundary. A very distinct constriction was now seen in the body of the tumour, producing the form of an ordinary hour-glass. This constriction corresponded with the ramus of the pubes over which it crossed. I opened the superior division of the hernial sac above this constriction, and exposed healthy intestine only. I next endeavoured to extricate the bowel from the inferior division of the sac; but I was unable to release it. A grooved director was carefully introduced into the inferior sac, and much blood-tinged serum escaped along the groove. Still, even when all the serum had run out, and traction was made on the bowel from above, it was inextricable! What chance then was there of reducing the bowel by the taxis? The constriction of the sac having been divided, the strangulated bowel was easily returned into the abdominal cavity without any enlargement of its abdominal orifice being required. The left testis was visible at the fundus of the sac—sufficient evidence that the hernia had descended into the vaginal process of the peritonæum. This man recovered.

Other cases of this kind have occurred in my practice. They are not, I suspect, quite so uncommon as at first sight we might be led to assume. Out of forty cases of oblique inguinal hernia, which Mr. Kingdon selected for me, in order to illustrate quite a different subject, I find that he observed the characteristic hour-glass constriction of the scrotal tumour in four men in whom the hernia was developed at the respective ages of 17, 29, and 30 years, and one in boyhood.

But what explanation can be given of the constriction of the bowel by the sac at such an unusual part? Let us seek for it by an examination of preparations and a reference to the physiological changes taking place in the vaginal process of the peritonæum before, or soon after, birth. Before doing this, let us distinctly isolate and exclude from the class of cases about which we are writing all those in which the impediment to the reduction of the hernia, or the cause of constriction of the bowel, depends upon the development of adventitious bands crossing the cavity of the sac without any definite or specific arrangement. Hernial sacs, showing such peculiarities as last mentioned, are preserved in the London museums; but they are quite foreign to our immediate purpose, and belong to a perfectly distinct category as regards their development and relations to the sac and its contents.

In the cases we are now describing the hernial protrusion and testis are in contact, otherwise the case would not belong to this class.

In the Museum of the Royal College of Surgeons there is a Hunterian preparation, No. 1343, thus described in the catalogue: 'The sac of a large congenital hernia. The exterior of the sac is uneven and sacculated, through the unequal yielding of different parts of its walls: the testicle is situated at the lowest part.' This account is not sufficiently explicit or descriptive of the structure of the hernial sac and its relations to the testis. A careful examination of the interior of the sac shows a large superior division and a small inferior. In the latter the testis may be recognised; but between the divisions an imperfect septum, or perforated diaphragm, existed before the vertical section of the entire sac was made, and by means of this foramen a communication was established between them. The sharp, well-defined, free edges of this septum are seen stretching from the sac-wall to the testis, as well as its strong attachment to the sac itself. Now assume the cut edges of this sac to be joined

[1] *Chir. Works*, edit. 8vo, 1808, vol. ii. pp. 118, 184, case xiv.
[2] *A Treatise on Hernia*; translated by Wishart, 8vo. 1814, p. 138, pl. v. fig. 2.

together, and the superior and inferior sacculi would be complete, although any foreign body might be passed from the one into the other. A hernia, for example, filling the upper sacculus, might pass from it through the aperture in the diaphragm into the lower, and then become constricted by the margins of this annular contraction.

But a preparation in the Museum at Guy's Hospital, No. 2368, at once affords a satisfactory clue to the solution of these somewhat remarkable cases. It is the vaginal process of the peritonæum taken from a child. It shows a portion of the parietal peritonæum of the abdomen with the whole process extending downwards from it. This process has been opened along the whole extent of its anterior surface. At the superior extremity the canal communicated with the abdomen, and at the inferior extremity the testis may be seen; and between these two points, about midway, the cavity is contracted. When this tube was uncut, there must have been an opening or narrow passage near its centre, through which a protrusion, escaping by the abdominal orifice, and traversing the funicular portion of the vaginal process, must have passed to reach the testis. A constriction resembling this formed the impediment to the reduction of the hernia in the cases above described.

Sir Charles Bell describes a hernial sac of this kind which came under his observation in connection with an obscure case of hernia, which he has recorded in the 'London Medical Gazette' of 1828.[1] 'There was another remarkable circumstance observed, which related to the sac lodged in the scrotum. At the lowest part there was a hole of communication between that sac and the cavity which is between the coats of the testicle. This orifice was so large that the finger could be passed through it; and its margins were so dense as to resist dilatation.' In the explanation of the woodcut, he writes: 'A bougie has been passed from the hernial sac into the cavity formed by the tunics of the testicle, through an opening which forms a communication between them.'

A careful examination of the second figure of the 2nd plate of Key's edition of Sir Astley Cooper's work on Hernia will satisfy any one that it delineates a case of the kind we are describing. It was a 'congenital hernia firmly constricted by an annular contraction of the sac itself,' although described as a 'a band of membrane adhering to the sides of the tunica vaginalis, *through an aperture in which* the intestine has protruded and become strangulated.' The hernia is seen both above and below this aperture; the portion below 'discoloured by the effects of strangulation' produced by its margins; the portion above, 'below the internal ring and above the strangulating band, free from pressure and retaining its natural appearance.' Now in this description we have but a repetition of the appearances I observed in the case under my own treatment, related on the previous page. In chap. xvi. on *Congenital Hernia*, Sir Astley Cooper states that in this variety 'the stricture is much oftener found to be *within the sac* than in the ordinary kinds of hernia;' and he relates a case, upon the authority of Mr. Hodgson, of Lewes, in which the intestine 'was found strangulated within an aperture of the tunica vaginalis. The intestine appeared to have suffered more from this stricture than from the ring.'

Lastly, Mr. Lawrence,[2] when describing cases of this kind, records one in which, 'about half-way between the testis and groin, the hernial sac was so contracted that a probe only would pass into the stricture.' In this case, too, the abdominal orifice of the sac 'would not admit the smallest portion of the tip of the finger,' and it also formed an impediment to the reduction of the hernia; in this respect differing from my case.

By these quotations, to which numerous instances might be added, especially those recorded by Mr. Pott, with dissections, case 14,[3] it is capable of demonstration that this class of cases must be confined to those forms of inguinal hernia dependent upon congenital defect or persistence of the vaginal process of the peritonæum throughout life.

But a glance at a plate in Camper's work [4] will more easily explain the nature of these cases. Fig. 2 shows the cavity of the right vaginal process of the peritonæum opened vertically from the abdomen to its inferior termination; at which point is seen the testis. Fig. 3 shows the left side, in which, just above the testis, the entire canal is divided into two portions by the internal surfaces of the serous membrane united together. Should it, however, happen that this septum is not complete, a mere contraction takes place, and a ring is thus formed, keeping up a communication between the persistent funicular portion of the vaginal process, which is above, and the cavity of the imperfect tunica vaginalis testis below. By the constant pressure around a hernia, the tissues composing this annular contraction of the hernial sac become more and more dense, until it forms a firm, fibrous callous ring at the situation where the tunica vaginalis ordinarily terminates just above the testis; its variable distance from that gland depending, in different cases, upon the larger

[1] Vol. i. p. 484; also a woodcut.
[2] *On Ruptures*, 5th edit. p. 574.
[3] His *Chirurgical Works*, edit. 1808, vol. ii. p. 184.
[4] *Icones Herniarum*, tab. x. 1801.

or smaller size of the protrusion, and the consequent distension of the tunica vaginalis testis.

The differential diagnosis between these cases, of hernia into the vaginal process of the peritonæum, and the ordinary form of inguino-scrotal hernia, is formed by the manner of their development, the age at which they first appear, and their configuration. Whilst the common form is developed slowly, these appear suddenly, and often pass at once into the scrotum without resting in the inguinal canal. They are noticed in the earliest infancy, throughout childhood, and during early adult life. Their form or outline is highly characteristic. The tumour projects in a remarkable manner from the external outlet of the inguinal canal; directly the rupture escapes from the embrace of the external abdominal ring, the form is more globular and rounded in comparison with the pyriform outline of the hernia of slow formation in adult life. The testis may or may not be felt; when it is easily detected, it is evident that the gland and rupture are in separate sacs, and *vice versâ*.

In the hour-glass-shaped variety the configuration alone is sufficient to attract notice and lead to its diagnostication.

When the hernia is reducible, the depth of the internal abdominal ring and the length of the inguinal canal are discoverable by tactile examination.

The importance of recognising these cases.—It is highly important to recognise the cases of hernia into the vaginal process of the peritonæum, in a practical point of view, especially in relation to their treatment. Much more severe constitutional symptoms usually accompany strangulation in these cases, and this condition of the hernia takes place more rapidly than when the hernial sac has been of slow formation. They require, therefore, the liberation of the bowel as soon as it is possible.

Considerable difficulty is experienced in reducing these protrusions by the taxis, in consequence of the depth of the orifice of the sac, the inability of the operator to fix it or command its movements, the contraction of its orifice, its unyielding textures, and the length of the neck of the sac, or that part of it lying between the two inguinal rings within the inguinal canal. In cases of the hour-glass contraction of the sac, the taxis is generally useless if the bowel has been strangulated but a few hours, and persistence in such attempts is extremely hazardous. Under any conditions, the surgeon must remember that two distinct and separate contractions exist, through which the rupture must have passed; one of these being situated in the body of the sac, the other being its true ventral orifice. Either of these contractions, or both of them, may offer insuperable impediments to the reduction of the hernia, unless their tissues be cut.

If we scrutinise any large number of cases of inguinal hernia admitted into the hospitals, a majority of those requiring the liberation of the bowel by a cutting operation are patients under 30 years of age. At St. George's Hospital, out of 28 males suffering with strangulated oblique hernia, 17 were under 30 years of age; 11 had passed that age.[1] At Guy's Hospital, of 57 cutting operations performed in order to liberate a strangulated inguinal hernia, 33 belonged to the class of which we are writing, 24 were of the old slowly-forming variety. Next, in order to demonstrate with how much greater facility the old inguino-scrotal hernia is reduced by the taxis, than that descending into the vaginal process of the peritonæum, we may refer to 129 cases of oblique inguinal hernia, admitted also into Guy's Hospital.

Of these, 59 had traversed the canal of the vaginal process of the peritonæum, 70 belonged to the old inguino-scrotal variety. Or, tabulated thus:

Of inguino-scrotal, the sac of which formed slowly	94 cases	requiring a cutting operation	24 or 25·53 per cent.
		reduced by taxis	70 „ 74·46 „
Of ing.-scrotal descending along the vaginal process of peritonæum	92 cases	requiring a cutting operation	33 or 35·86 per cent.
		reduced by taxis	59 „ 63·04 „

[1] *Medical Times and Gazette*, 1861, vol. i. p. 624.

Another subject of great importance relates to the application of the taxis. In some of those cases in which the hernia, when strangulated by the orifice of the sac, was supposed to have been returned into the abdomen in a mass, more careful examination after death showed that the inguinal portion of the sac was burst, and that the bowel had been pushed through the laceration, and was lying outside the peritonæum, between it and the internal abdominal fascia. This accident is more fully described at page 780. In these cases, also, the mouth of the sac is sometimes detached from its connections. When the patient is youthful, and the anæsthetic effects of chloroform are fully produced, great caution is, therefore, necessary in using the taxis, on account of the slight and delicate connections of the peritonæum to the neighbouring parts at this early age.

Difficulties also attend the operations on these cases, in consequence of the depth of the orifice of the sac, the variable position of the testis, and the varieties which may be encountered in the disposition of the hernial sac, all of which have been before described.

Infantile hernia.—The infantile hernia of Hey, and the encysted hernia of the tunica vaginalis of Astley Cooper, are synonymous terms for a variety of the oblique inguinal hernia, depending likewise upon an abnormal condition of the tunica vaginalis peritonæi. The state of that sheath which precedes the development of this kind of hernia depends upon the ventral orifice being closed, but the canal persisting from that point to the testis. The hernia slowly pushes before it the parietal peritonæum of the abdomen into this sheath, and when the parts are dissected it is seen that 'the tunica vaginalis is continued up to the abdominal ring, and encloses the hernial sac,' as Mr. Hey describes. In this manner 'the protruded parts, together with the sac, are contained in the tunica vaginalis testis' (Lawrence, 'A Treatise on Ruptures,' p. 576).

The name given by Hey to this variety of hernia leads the reader to infer that it is always developed in infancy. This, however, is not the fact. Hey's case was an infant, fifteen months old. Forster's case, related by Cooper, was thirty-one years old at the time of the operation. The duration of the rupture is not specially stated, but the description induces us to believe that it had not existed long. In Lucas's case the rupture was developed at about seventeen years of age. The man in Forster's second case had been ruptured all his life. Mr. Holmes reports a case in which the rupture was developed at about twelve years of age; and I operated upon a man in Guy's Hospital, forty-two years old, who was not ruptured until he had completed his thirty-fifth year.

Cases of this kind are very rare. Their precise nature is usually only detected during the time of the operation, when the surgeon finds that on cutting into the tumour, a serous cavity is opened, which contains the hernial sac, invested externally by a serous membrane. Within this, the true hernial sac, the rupture is found. The operator may also be a little puzzled by finding the tumour so remarkably movable, after he has incised the first serous sac. The whole tumour, with the testis attached to its walls, falls out, and seems to be only suspended by its attachment to the margins of the external abdominal ring.

Inguino-scrotal hernia of slow formation.—That variety of oblique inguino-scrotal hernia which occurs in middle and late adult life, and forms for itself its own sac by pushing the parietal peritonæum before it, causes at first a slight swelling at the internal abdominal ring, slowly traverses the inguinal canal, and at last occupies more or less of the scrotum. To the 'pointing' of the hernia at the internal inguinal ring, as M. Malgaigne aptly terms it, the attention of the surgeon is sometimes drawn. Upon inspection, a slight elevation of the integuments over the internal inguinal ring is observable, which becomes more prominent when the patient contracts the abdominal muscles or coughs, especially if standing erect. In this posture, and under similar influences, if the finger be placed over the ring, the hernia is projected against it, and the sensation thus induced is termed the impulse of the rupture.

At this period a truss should be constantly worn. If made to fit comfortably, it will prevent the further escape of the viscera; and by counteracting their propelling force against the parietal peritonæum, the development of the hernial sac is arrested.

As the hernia descends further from the internal inguinal ring, it produces a swelling in the inguinal canal. The long axis of the tumour is parallel with Poupart's ligament, and therefore follows the oblique direction of that firm, fibrous structure, from above, downwards and inwards. This bubonocele, as the tumour is usually called, is covered by the integuments of the groin and the aponeurosis of the external abdominal oblique muscle. Along its superior border it is overlapped by the free edge of the internal oblique and transversalis muscles; along its inferior by the cremaster muscle. It lies upon the internal abdominal fascia as it emerges at the internal inguinal ring, afterwards upon the conjoined tendons of the internal oblique and transversalis muscles, just before it reaches the external inguinal ring. Under these dispositions of the fleshy and tendinous fibres of the abdominal muscles, the hernial sac with its contents is in a very especial manner under the influence of their contractions; more especially in the region of its mouth and neck: hence a frequent impediment to the reduction of a hernia. The spermatic cord usually lies behind the tumour at the internal inguinal ring, and is attached to the posterior surface of the sac as it traverses the inguinal canal.

As the development of the sac advances, it is pushed through the external inguinal ring, over the os pubis, and into the scrotum. As the hernia points at the external inguinal ring, it forms a somewhat globular swelling; but as its bulk increases, in its progress towards the fundus of the scrotum, the shape of the tumour is generally pyriform, when the scrotum is distended with the hernia. In the body of the tumour contractions or depressions, generally following an oblique or transverse direction, are occasionally observable. Such appearances are due to the more or less yielding tissues of the scrotum.

The testis is usually below the tumour, sometimes behind it. The elementary structures of the spermatic cord may be traced along its posterior or outer boundary, generally close together, side by side, but sometimes, though very rarely, separated from each other.

When the hernia is reduced, the forefinger may be passed with facility into the abdominal cavity through the external inguinal ring, the inguinal canal, much shortened, and the internal inguinal ring. This is practicable on account of the approximation of those rings taking place from the pressure of the hernia, and the relaxation of the surrounding structures. The mouth of the sac and the inguinal apertures are indeed sometimes so stretched that the finger may be freely passed to the abdominal surface of the symphysis pubis; and the pulsation of the epigastric artery, or of the external iliac, may be felt in the usual situations of those vessels.

Diagnostication.—Every inguinal hernia escapes from the abdominal cavity above Poupart's ligament. If, therefore, the tumour formed by an inguinal protrusion be examined whilst in the inguinal canal, Poupart's ligament is traceable along its inferior border, and the opening where the tumour seems to make its escape from the abdomen is above the same fibrous band. It may be always distinguished, then, from crural hernia; for that kind generally escapes through the crural ring, which is situated behind and below Poupart's ligament, and that ligament may be always traced along the superior border of the tumour. Figs. 163, 167 should be compared.

Again, an inguinal hernia reaches the scrotum through the external inguinal ring, the outer pillar of which is formed by the pubic attachment of Poupart's ligament to the spinous process of the pubes. Now place the tip of the finger upon the last-mentioned process of bone, and if the neck of the tumour lies to its inner side, or between the finger and the symphysis pubes, the tumour must be formed by a protrusion which has passed through the external inguinal ring; a fact sufficiently demonstrative of an inguinal hernia. Should the tumour be to the outer side of the finger, the probability is that the hernia has passed through the crural ring.

A Tabular Arrangement of the Characteristics of the three varieties of Oblique Inguinal Hernia in Males.

A. Into the VAGINAL PROCESS of the PERITONÆUM. (*Hernia congenita* Halleri.)	B. Into the FUNICULAR PORTION of the vaginal process of the peritonæum	C. INGUINO-SCROTAL; into the tissues of the scrotum
1. Is developed most commonly in infancy; occasionally in youth; rarely in adult life.	1. Is developed frequently in infancy; often in youth and in adult life.	1. Occurs in adults, I believe, exclusively.
2. Is suddenly produced.	2. The same.	2. Is slowly produced.
3. At once descends along the inguinal canal into the scrotum.	3. The same.	3. By slow degrees traverses the inguinal canal and scrotum.
4. May rest in the inguinal canal when the testis is *not* in the scrotum.	4. May rest in the inguinal canal when the testis *is* in the scrotum.	4. May remain in the inguinal canal for an indefinite period, the testis being in the scrotum.
5. Envelops the testis, and lies in contact with that organ.	5. The testis, at the fundus of the scrotum, occupies its own serous sac, which separates it from the hernia. It usually produces a very distinct prominence at this part.	5. Is separate from the testis, which is at the fundus of the scrotum, usually.
6. The orifice of the hernial sac is contracted, and corresponds with the site of the internal abdominal ring.	6. The same.	6. Orifice of the sac large and near the external abdominal ring.
7. Neck of the sac long and tubular; it lies in the inguinal canal, between the rings, which are *not* approximated, even in the adult.	7. The same.	7. Neck of sac short, dilated; inguinal canal shortened; the rings *being* approximated.
8. Hernial sac a direct congenital prolongation of the peritonæum; tubular when not distended with a hernia. It reaches the testis in the scrotum, and envelops it. Thus there is a congenital serous canal to receive the hernia.	8. Hernial sac, a direct congenital prolongation of the peritonæum; tubular when not distended with a hernia. It does not extend into the scrotum so low as the testis. A congenital serous canal exists to receive the hernia.	8. Hernial sac a new formation, and slowly developed by the pressure of the abdominal viscera against the parietal abdominal peritonæum, which by extension before the hernia is thus formed into a sac for it. Here the hernia forms its own sac by pushing the peritonæum before it. The tubular character of the sac is wanting.

Differential diagnostication.—The surgeon is often required to distinguish between inguino-scrotal hernia and some other tumours developed in the inguinal region and scrotum.

These are—1st, the different kinds of hydrocele; 2nd, the encysted spermatocele connected with the epididymis; 3rd, varicocele of the spermatic veins; 4th, inflammation of an old hernial sac, and the results of such inflammation; 5th, inflammatory affections and other diseases of the testis, the cord, and their coverings; 6th, hæmatocele; 7th, malpositions of the testis; 8th, inflammatory and other diseases of the inguinal lymphatic glands; 9th, growths of fat in the connective tissue of the inguinal canal and upon the spermatic cord; 10th, diseases of the integuments of the scrotum, especially growths, as elephantiasis.

The nature of these diseases being described in other parts of this work, the observations we have to make in relation to the differential diagnosis between them and inguino-scrotal ruptures may be condensed into a tabular form. This plan was suggested by the perusal of a chapter written by M. Vidal (de Cassis), entitled 'Chronic Tumours of the Scrotum considered in a Diagnostic Point of View.'[1]

To one variety of hydrocele it is perhaps necessary to make a special allusion. In rare instances serum collects in the vaginal process of the peritonæum, when its ventral orifice is patent, and the accumulated fluid may be pressed out of the scrotum into the peritoneal cavity through that aperture. This condition usually occurs in infants, but we have seen it in adults, complicated even with a hernia. The differential diagnosis is stated in the table.

The chronic tumours of the scrotum may be arranged in two divisions:

I. The reducible. (See table below.)

II. The irreducible. (See table on next page.)

Characteristics of the Reducible Tumours compared with Hernia.

	Their entrance or return into the abdomen		Their passage from the abdomen
	Characters in common	Special characters: when without complications	Special characters
1. Inguinal hernia.	*All* return into the abdomen most easily when the patient lies down on the back and when the abdominal muscles are relaxed.	1. *Hernia* enters most readily. When once commenced, passes in quickly and suddenly. Entrance complete. Opaque and thick neck of tumour. Testis may or may not be perceptible until reduced. *No* vibration.	1. Is developed from above, descends when the patient rises or exerts the abdominal muscles, and more quickly than others. The finger pressed over the ring prevents its descent.
2. Hydrocele of vaginal process of peritonæum.	—	2. *Hydrocele* of vaginal process of peritonæum enters slowly, and never suddenly. Entrance complete. Translucent and small neck of tumour. Testis imperceptible until the fluid has entered the abdomen. Vibration.	2. Seems to be developed from below upwards. The serum sometimes remains in spite of the horizontal position.
3. Hydrocele of funicular division of vaginal process of peritonæum.	—	3. *Hydrocele* of funicular division of vaginal process of peritonæum enters like No. 2. Entrance complete. Translucent. Neck of tumour may pass into inguinal canal. Testis perceptible at fundus of tumour. Vibration.	3. Similar to No. 2.
4. Varicocele.	—	4. *Varicocele* enters very slowly. Entrance not complete, the bulk of tumour only diminished. *No* vibration.	4. The tumour increases like hernia when the patient rises; but it increases also if pressure be made over the course of the spermatic veins in the inguinal canal, or if the blood be retarded in its passage along them in any way.

[1] *Traité de Path. externe*, edit. 1841, vol. v. p. 715.

Characteristics of the Irreducible Tumours compared with Hernia.

Disease	Weight	Translucency	Fluctuation and vibration	Relation of testis to tumour	Figure and development	Size	Consistence	Pain
HERNIA . .	Lighter than either the fluid or solid tumours.	Very rarely so; generally opaque.	Only when fluid co-exists with the hernia.	Position variable, but the testis usually discoverable.	Pyriform, but with *thick* neck. Occasionally globular or ovoid. Outline regular. Begins at neck of scrotum and descends.	Variable; at times very large.	Soft and yielding, except it be omental.	Painless, unless diseased.
FLUID TUMOURS .	Hæmatocele rather heavier than hydrocele.	Hydrocele particularly so. In rare cases opaque. Hæmatocele opaque.	Distinct; vibration very characteristic, as in hydrocele.	Perceptible in spermatocele; not in hydrocele of tunica vaginalis propria testis, usually.	Pyriform, but with very thin neck. Outline very regular. Globular as hydrocele of spermatic cord. Oblong as in spermatocele, and nearly transverse to vertical axis of scrotum. Begin near fundus of scrotum and ascend.	Rarely very large.	Yielding and elastic. Exceedingly incompressible as hydrocele of cord.	Painless, unless testis be squeezed, usually.
SOLID TUMOURS .	Generally heavier than fluid.	Opaque.	Absent.	Often involved and imperceptible though its site may be discoverable by pressure.	Outline of testis often preserved. Sometimes surface irregular.	Large; steadily increasing.	Resisting, firm and rarely hard.	Painful, but variable in degree.
MIXED TUMOURS .	Heavy.	Sometimes in parts of them.	In some parts, not in others.	Involved.	Irregular outline.	Large; at times rapidly increasing.	Resisting in parts, soft in others.	Variable.

In the first division there are :

1. Inguinal hernia.
2. Hydrocele of the vaginal process of the peritonæum.
3. Hydrocele of the funicular portion of the same process.
4. Varicocele of the spermatic veins.

The tumours in the second division are composed very often of fluids only, sometimes almost exclusively of solids, but occasionally of both solids and fluids in variable proportions.

Those composed of fluids are—1, hydrocele of the tunica vaginalis propria testis; 2, hæmatocele in the same sac when first developed; 3, encysted spermatocele connected with the epididymis; 4, hydrocele of the spermatic cord.

Those formed by solids, or of solids and fluids, are—1, the diseases of the testis, *a*, of inflammatory origin, *b*, specific new growths; 2, hæmatocele of some standing in which changes have taken place; 3, diseases of the spermatic cord; 4, growths of fat extending from the inguinal canal into the scrotum or in its tissues; 5, diseases of the tissues of the scrotum.

Between the local signs of an inflamed scrotal hernial sac, especially if its orifice be plugged by omentum, and an inflamed hernia, there is a close resemblance. But from the history of the case, and the absence of those constitutional symptoms which accompany an inflamed hernia, a correct diagnostication may be formed.

The inflammatory conditions of the testis, the cord, its coverings, and the tissues of the scrotum, do not resemble hernial tumours either in their local or constitutional manifestations. It is more probable that a hernial protrusion might be considered to be some affection of those organs, than that they should be mistaken for a hernia. The history of the case usually removes all doubt as to its nature.

Treatment.—The palliative treatment of reducible oblique inguinal hernia consists in maintaining perfect and unintermitting retention of the hernia; for if this be done carefully and with method, a permanent cure may be effected, especially in children. The cases of hernia into the vaginal process, if carefully treated immediately after the first appearance of the rupture, and before the walls of that canal have been stretched for any length of time, are generally cured by the employment of a well-adjusted truss. But in the use of this instrument before puberty, great attention must be given to the site of the testis; for the pad of the truss might press injuriously upon that organ. The spring of the truss must not be too powerful; for if the pressure of the pad upon the walls of the abdomen is very strong, their tissues are absorbed where the pad presses, and they become, in consequence, seriously weakened. The pad should prevent the escape of the hernia by its accurate adjustment, rather than by the force with which it presses against those apertures through which the hernia passes. On this account, each individual requires to have a truss adapted to the configuration of the body. The pad should be applied over the internal inguinal ring, pressing gently upon the inguinal canal to afford support to the tissues of that part, and not upon the external inguinal ring and pubes, as we have often seen it applied. The patient should be enjoined to wear the truss uninterruptedly, except only when lying in bed; to adjust it carefully before leaving bed in the morning, and on no account to permit the hernia to remain for a moment in the sac.

When the hernia has acquired large dimensions, or has become irreducible, a particular form of appliance, termed the bag-truss, becomes indispensable.

The radical cure of reducible inguinal hernia.—The commonly unsuccessful issue of the operations performed on the principle of invagination, as advocated by Gerdy, Wutzer, and others, induced Mr. Wood to search for the cause of failure. This he attributes to the want of union between the invaginated tissues and those lying behind them. The theory of Wutzer's operation is to induce adhesion between the fundus of the hernial sac and the entire circumference of its orifice, as well as entire obliteration of the other parts of the sac by adhesive inflammation. Unfortunately, however, the results of practice do not uphold the theory.[1]

[1] See page 760 for the general principles which should guide the surgeon as to these operations.

Mr. Wood[1] has contrived an operation by which he believes the chances of failure above mentioned are prevented. The operator requires a special needle, scalpel, compress made of wood, glass, or porcelain, and some strong hempen thread. The contraction of the abdominal muscles should be completely controlled by the influence of chloroform.

After an incision has been made through the skin of the scrotum, the forefinger of the operator is pushed behind the hernial sac as far as possible into the inguinal canal, and in front of the spermatic cord, at the same time invaginating the tissues. The needle is next carried by the side of the finger and passed through the conjoined tendons of the internal oblique and transversalis muscles, the inner pillar of the external inguinal ring, and the integuments. Great care is required to avoid including the spermatic cord. A thread is next passed through the eye of the needle, and the latter is withdrawn, leaving one end of the thread in the puncture. The needle, still threaded, is next passed through the aponeurosis of the external abdominal oblique muscle near to Poupart's ligament, and opposite to the internal inguinal ring, and its point brought out through the opening in the integuments first made by it. A loop of thread is left behind, and the needle, with the thread still in it, is again passed through that portion of the conjoined tendons which lies over the rectus muscle, close to the pubic spine and the inner pillar of the ring. Its point is now brought through the first puncture for the third time, and the needle altogether withdrawn from the thread.

Thus a loop and two ends of thread pass through one opening in the skin. 'Two portions of thread are thus placed across the hernial canal, invaginated fascia and sac, closely embracing, but not including, the spermatic cord, and connecting the posterior or deep wall with the anterior and superficial, perforating the aponeurosis of the external abdominal oblique muscle in three places; but escaping by the same aperture in the skin' (Wood). The compress is next applied over the canal obliquely, and the two ends of the thread passed under the loop and tied in such a manner as to give equable adjustment to the pressure.

The after-treatment of the case is the same as that adopted in similar operations.

Mr. Wood described several modifications of this operation in which wire was used with good results.

The taxis.—When a surgeon has a case of irreducible inguinal hernia to treat, his attention should be particularly devoted to a very careful examination of the tumour, in order to diagnosticate the variety under observation. He should ascertain with accuracy the anatomical relations of the tumour to the surrounding parts; the position of the testis, especially; the length of time the patient has been ruptured; the mode of development of the hernia, whether suddenly or slowly; the treatment pursued to prevent the protrusion from taking place; and the history of the present state of the rupture.

Having determined the variety, if the state of the tumour permit, he may employ gentle pressure in order to reduce the protrusion, remembering the direction or course it has taken, and the circumstances which probably cause the impediment to its reduction. The abdominal muscles must be relaxed as much as possible whilst the patient lies on the back.

It is only necessary to describe, in this place, the manipulative proceedings, as the constitutional measures employed to render them more effective have been detailed at pp. 775–6. A very much larger proportion of the cases of inguinal hernia are now reduced by taxis than formerly. This is due to the use of chloroform, the effects of which in producing total annihilation of the contractile function of muscular tissue are so important. Small inguino-scrotal protrusions are not reduced with the same facility as large ones. When such a protrusion occurs in a young person, and has been only recently developed, after a fair trial of the taxis, when the patient is fully under the influence of chloroform, and the efforts to reduce it have failed, any delay

[1] *On Rupture: Inguinal, Crural, and Umbilical, &c.*, by John Wood. 8vo. London, 1863.

in removing the impediment to the replacement of the hernia is reprehensible. To resort to any other measure which necessitates the occupation of time, is only to abandon the sufferer to additional risk of the loss of life.

If the protrusion be compound—that is to say, when it consists of a large mass of omentum and a very small knuckle of bowel—the reduction of the latter is effected with difficulty. The same thing occurs when the hernia is one of irreducible omentum of long standing, from old adhesions, and a small piece of bowel. Also, when the sac is distended and rendered very tense by a considerable effusion of serum. The efforts of the surgeon to reduce the bowel are thereby rendered abortive; for if the serum cannot be made to pass through the mouth of the sac into the abdomen, the hernia never will.

The operation.—The patient should lie on the back, with the pelvic region slightly elevated, unless some firm, resisting body, as a mattress, cushion, or table, be underneath. The anatomical points which the surgeon particularly wishes to reach or display in the cutting operation are, the external inguinal ring, the aponeurosis of the external abdominal oblique muscle, the internal inguinal ring, and the mouth of the hernial sac. The various structures which constitute the coverings of the hernial sac need not be displayed with rigorous anatomical precision. They differ exceedingly in density and development in different cases. The length of the incision should not be proportioned to the size of the hernia. Its length must be just sufficient to expose freely the anatomical points alluded to above, and no more. In ordinary cases, the point of the scalpel should be inserted through the integuments at about one to two inches above the assumed centre of the external inguinal ring, and carried downwards upon the anterior surface of the tumour, to terminate about two or three inches below the same mark. The margins of the external inguinal ring are next carefully exposed, and their relations to the tumour examined. They should not be cut unless it be imperatively required to do so. The deeper coverings of the hernial sac are next carefully incised, with or without the assistance of a grooved director, until that important structure is reached.

The operator, pressing his finger upon the sac, next insinuates it through the external inguinal ring, in order to ascertain if there be any structures which firmly encircle the neck and orifice of the sac outside. Should he discover any, a grooved director may be guided by the finger underneath them, and they may be cut. After slight pressure made upon the sac, its contents are sometimes returned into the abdomen at this stage of the operation. If their reduction be not practicable, the peritoneal sac must next be opened. It must be done after the manner described at p. 783, and with great care. Probably some serum will escape when the sac is cut, but this is not always the case. The opening in the sac requires to be sufficiently large to allow the operator to reach its orifice easily, and to examine its contents. The index-finger is now passed along the anterior surface of the protrusion upwards towards the mouth of the sac, when an impediment to its further passage is encountered. The tissues which bound this narrow opening constitute the impediment to the reduction of the hernia. The operator next passes the hernia bistoury along a grooved director or upon his finger, through the mouth of the sac, and divides the structures in contact with the knife sufficiently to allow the ungual phalanx to be passed freely into the abdominal cavity. The direction of this incision should be parallel with the linea alba. A few small arteries are occasionally cut during the operation, which may be twisted immediately.

Oblique inguinal hernia in the female sex.—This variety occurs at very early periods of life. In fact, with the exception of umbilical hernia, it is the only kind developed before five years of age. Even until the age of puberty it is more common than any other variety. Its development in infancy is due to the patulous state of the vaginal process of the peritonæum, otherwise known by the name of the canal of Nuck. Doubtless such a condition of this process remains throughout early life, into which a hernia occasionally and suddenly descends. In the adult female this

hernia generally forms slowly after thirty years of age. But I have met with double inguinal hernia in a well-formed woman aged only twenty-four years, who had never been pregnant; she had worked hard, however.

Its anatomical relations are alike in both sexes, merely substituting the round ligament in the female for the spermatic cord of the male, and the labium pudendi for the scrotum.

It is commonly believed that inguinal hernia is much more rare in women than femoral. However, this belief seems to be unfounded. Mr. Kingdon's valuable tables show that in the years 1860 and 1861, 1,582 females at all ages, suffering with either one variety of hernia or the other, came under his observation. Of these 761 were afflicted with inguinal hernia, and 821 with femoral. Or, inguinal hernia was only thirty less than half the total number, whilst femoral was but thirty more than half. Mr. Kingdon told me that it is not uncommon to feel the ovary in the sac of an inguinal hernia of an infant.

The tumour formed by an inguino labial hernia rarely attains the size so often reached by inguino-scrotal. Still, we have seen one which descended more than half-way below the middle of the thigh, and the coverings of which had become so attenuated that the convolutions of the intestines were distinctly visible. When of moderate size, it is generally of a more globular figure, and it has a longer, more contracted, narrow, and cylindrical neck, than in the male sex.

In forming a correct diagnostication of this hernia in the female, the same anatomical points must be taken as guides which have been already described when that in the male sex was under consideration. The surgeon should, however, particularly remember that a hydrocele of the round ligament, or of the canal of Nuck, is occasionally developed, which might lead to an error in diagnosis.

The palliative measures described as being suitable in the treatment of cases of inguinal hernia in the male sex are applicable in these also; but if the hernia become strangulated, the surgeon must act with promptitude and decision. In the cases we have seen, under these circumstances, the symptoms have usually been rather severe at an early period of the attack; and in those upon which we have been required to operate, the impediment to the reduction of the bowel was at the orifice of the sac, and certainly insuperable without a cutting operation.

In the female sex, the operator must be guided by the same anatomical points in his attempt to reach the mouth of the hernial sac as in the male. And he should remember that, occasionally although very rarely, the bowel may be constricted by a contraction of the sac itself near the external inguinal ring, and not by its ventral orifice only.

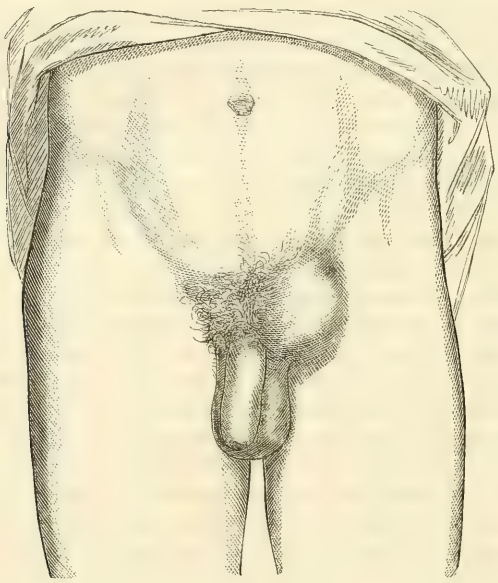
Direct inguinal hernia.—The variety of inguinal hernia characterised by the term 'direct' occurs in both sexes. It belongs to that class in which the hernial sac is formed slowly, or is an accidental or acquired formation. The only exception to the slow mode of formation is in those rare cases when the structures immediately behind the external inguinal ring are lacerated by violence and a hernia protrudes. It is never the result of a congenital imperfection. This variety is sometimes styled the internal inguinal, from the fact that the mouth of the sac, where it is continuous with the parietal abdominal peritonæum, is placed to the inside of the internal epigastric artery. It is comparatively rare.

At its commencement it forms a prominence where it points behind the external inguinal ring, through which it passes into the upper part of the scrotum. The outline of the tumour which it forms is more globular than that produced by the oblique course of the variety before described. It seems to be produced by something which escapes at once or directly from the cavity of the abdomen. Hence, probably, its specific name. The mouth of the sac is close to the outer border of the pubic attachment of the rectus muscle, the posterior surface of which may be much more easily felt when the hernia is reduced than in the oblique variety. On the outer side of the orifice of the sac the pulsations of the internal epigastric artery may be felt.

The finger enters the abdominal cavity much more readily in direct inguinal hernia than in oblique. Upon ocular examination from a short distance it will be seen that a line passing through the vertical or long axis of the tumour lies parallel with the linea alba, and there does not appear to be any inclining or curving of the neck of the tumour outwards and towards the crest of the ilium, as is observed in one formed by oblique inguinal.

In its passage from the abdomen a direct hernia merely traverses that small portion of the inguinal canal which lies immediately behind the external inguinal ring, and those structures which form that part of the floor of that canal are either pushed before the hernia, or they are lacerated when the hernial sac escapes through the opening so formed. Those structures are the conjoined tendons of the internal oblique and transversalis muscles and the pubic portion of the internal abdominal fascia. The spermatic cord and round ligament are not attached to the hernial sac

Fig. 166.—Direct Inguinal Hernia.



until it has reached the external abdominal ring. When it has passed that point, they lie to its outer side, and are usually less identified with its tissues than in the oblique variety.

The diagnostication between this variety of inguinal hernia and oblique must be formed under the guidance of the facts before described.

The palliative treatment requires a particular kind of truss, which must be so constructed as to give support to the defective abdominal walls posterior to the external inguinal ring.

The method of exposing and opening the hernial sac to liberate a strangulated bowel does not require any special description here. Facts, however, worthy of note are, that after the division of those structures superficial to the external inguinal ring, the spermatic cord may appear to be unusually distinct, and that the deeply-seated coverings of the hernial sac are often very attenuated. Considerable care is therefore required in the operation of incising them.

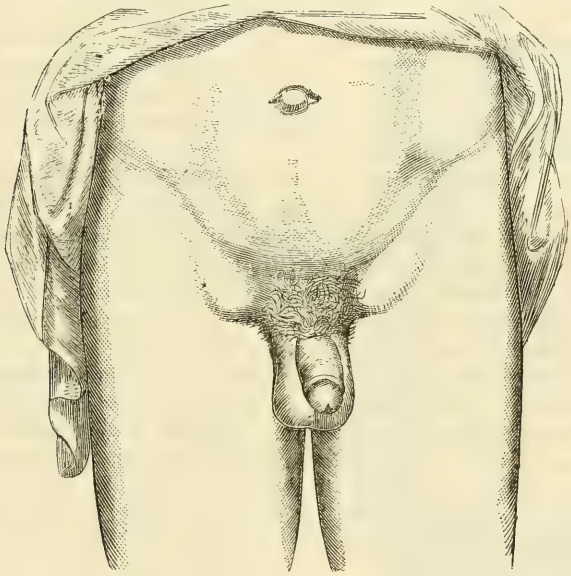
Inguinal herniæ sometimes pass through abnormal apertures in the aponeurosis of the external abdominal oblique muscle.—It would be an oversight not to allude to the fact that an inguinal hernia sometimes passes through an opening or division of the fibres in the aponeurosis of the external abdominal oblique muscle close to the ring, and not through the true external inguinal ring, which is then traversed by the

spermatic cord alone. Such anatomical varieties are rare, and would only require some slight modification of the operation to meet their peculiarities.

Femoral hernia, also called crural or merocele, was not accurately distinguished from some forms of inguinal until the middle of the seventeenth century. Its designation in a measure indicates the region of the body where it forms a tumour, which, however, may be stated, with greater precision, to be the upper and inner part of the thigh. Its anatomical relations were not accurately defined for many years after it was known to pursue a different course to inguinal; and it is curious to follow the gradual development of our knowledge of those structures immediately interested in, or associated with, this variety of rupture.

The principal anatomical points which should be examined, from the outside of

Fig. 167.—Double Femoral Hernia, the outline of Poupart's ligament being remarkably distinct *above* the tumour formed by it.



the thigh as well as from within the abdomen, are the following: the ligament of Fallopius or of Poupart; Gimbernat's ligament; the crural canal or ring; the fascia transversalis and iliaca, or the internal abdominal fascia of the iliac fossa; the falciform process of the fascia lata and the saphenous opening; and, when a hernial sac exists, the fascia propria of Sir Astley Cooper.[1]

Relations of the mouth of the hernial sac to the internal epigastric artery and vein. The orifice of the peritoneal sac holds important relations to the internal epigastric vessels. Some pathologists have established three varieties of the ordinary kind of crural hernia on this basis. The first, in which the orifice of the sac is situated to the outer side of the epigastric, external crural hernia; the second, where it lies to the inside of the same vessels, the middle crural hernia, the most common; the third, in which it is placed to the inner side of the remains of the obliterated umbilical artery. The first and third varieties are very rare.

Here we may also state that the obturator artery is occasionally given off from

[1] The anatomy of these various parts must be assumed to be known by the reader. We may, however, allude here to the importance of noticing the structure last named, viz. the fascia propria, first described by Sir Astley Cooper from a dissection made in 1800, and which is still preserved in the Museum of Guy's Hospital (No. 2503). It is an envelope which is found on the outside of the peritoneal sac, usually separated from it by a layer of adipose tissue.

the internal epigastric or femoral, and that when the former vessel lies to the outside of the orifice of the hernial sac, the obturator artery may cross closely over its neck, and dip down by its inner side to enter the obturator foramen.

A very interesting case, with a well-drawn illustration, is recorded by Mr. Spence in the 'Edinburgh Medical Journal,' July 1855. The pulsation of a large vessel was felt with the finger before its division.

Varieties in the course pursued by the sac of a crural hernia.—In a memoir published by Dr. Le Gendre, he describes four rare varieties of crural hernia.[1] They may indeed be regarded rather as curiosities, on account of their rarity.

1. The hernia, as soon as it traverses the crural ring, passes directly internal to and behind the femoral vessels, and rests on the pectineus muscle, the aponeurosis of which sometimes forms an envelope to it; this he calls the pectineal crural hernia, on account of its situation, or the hernia of Cloquet, in honour of the surgeon who was the first to describe it. Callisen, Vidal (de Cassis), M. Richet, Dr. Le Gendre, and Mr. J. Adams,[2] have recorded similar cases.

2. This variety, although placed internal to the femoral vessels, is, however, rather far from them; it passes through that resisting fibrous structure which bounds the crural canal and sheath internally; that is to say, the ligament of Gimbernat. Laugier, who was the first to notice it, calls it the *crural hernia through Gimbernat's ligament*, or the hernia of Laugier. Cruveilhier, Demeaux, Nuhn, and Le Gendre have also dissected cases of this kind.

3. This comprehends the variety of crural hernia which Hesselbach has so well described and figured.[3] The hernia in this case traverses several openings in the fascia cribriformis, and then presents several distinct lobes, which give it a characteristic appearance; it is *the hernia with a diverticulum through the cribriform fascia*, or the hernia of Hesselbach. Le Gendre and Malgaigne have dissected examples of this variety of rupture, which the former believes to be not so very rare.

4. Lastly, a variety in which the hernia, after having escaped beneath Poupart's ligament and traversed the cribriform fascia, sends one or more prolongations through the superficial fascia. This variety may be termed *the crural hernia with a diverticulum through the superficial fascia*, or the hernia of Astley Cooper.[4] Le Gendre describes a dissection of a case of this kind, and publishes a drawing of it in his work.

We may add a variety described by Mr. Partridge,[5] in which the hernia was situated external to the femoral vessels.

Development of the sac of a crural hernia.—The peritoneal sac of a crural hernia is always a secondary or acquired formation. It is never the result of a congenital defect. An opportunity of observing the early stage of a crural hernial sac commonly occurs in post-mortem examinations. The point of the finger may be pressed into a fossa, or even a sacculus, of two or three inches in length, between the femoral vein and Gimbernat's ligament. An observer is enabled, in this way, to thrust the parietal peritonæum down upon the thigh at this spot for an inch or more below Poupart's ligament. And this opportunity is the most favourable for the study of the relations of the sac of a crural hernia. By degrees such a digital depression of the peritonæum at the crural ring becomes in a living person dilated into a sac by the repeated and continued pressure of the viscus which forms the hernia. The sac extends lower down upon the thigh beneath Poupart's ligament; but, instead of descending lower and lower towards the knee, it usually dilates in a direction towards the crest of the ilium, so that the long axis of the tumour lies parallel with

[1] *Mém. sur quelques variétés rares de la Hernie crurale; avec 6 planches.* 8vo. Paris, 1858.

[2] *Med.-Chir. Trans.* 1860, p. 127.

[3] *De ortu et progressu Herniarum*, 4to. 1816.

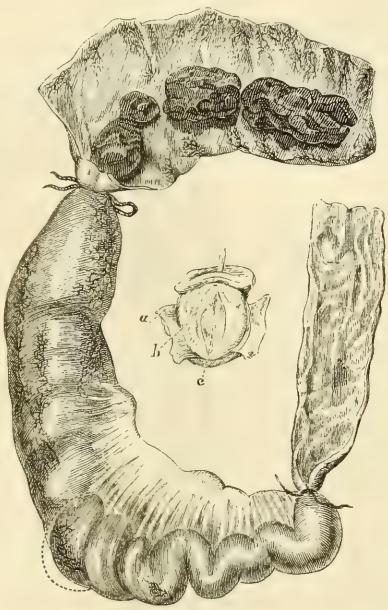
[4] *Anatomical and Surgical Treatment of Abdominal Hernia*, chap. xx.; case of Mrs. Sheffield.

[5] *Trans. Path. Soc.* vol. i. p. 99.

Poupart's ligament and upon the fascia lata. When large, the tumour even overlies that ligament, and seems to occupy the region in front of the inguinal canal. But in every case of crural hernia the tumour is formed by a protrusion which has escaped from the abdominal cavity below and behind Poupart's ligament; therefore the surgeon is able to trace that structure running along its upper border.

Crural hernia rarely increases to the size of inguinal. But occasionally, after an operation for the liberation of a strangulated bowel, when the tissues around the crural aperture have been weakened by cutting them, and the sufferer has neglected to employ the support afforded by a truss, nearly the whole of the alimentary canal may protrude. In such cases the walls of the sac become so remarkably attenuated that the peristaltic movement of the intestinal convolutions is distinctly seen through them; so attenuated as even to excite astonishment that the vitality of the integuments should be maintained. A very rare variety, as regards figure, we once saw in a man. The tumour was of a cylindrical shape, and extended downwards and inwards over the thigh, reaching as low as the middle of that region. The great size of the tumour is not a feature of serious importance, for a very small sac, having a contracted orifice, more readily entangles the hernia and prevents its reduction.

FIG. 168.—A piece of the Ileum three feet from the Cæcum removed from a patient, aged 57, who had been operated upon for Strangulated Femoral Hernia of seventy-three hours' duration.



The patient survived the operation forty hours, and the first symptoms of the attack 118 hours. She had been in bad health previously, was extremely emaciated, and sank from exhaustion. Large and hard masses of scybalæ were found in the ileum as shown in the part of the bowel cut open. The small piece of bowel which had been in the sac, and was but little diseased, is indicated by the dotted line. The contracted and opened bowel below this contained mucus only. The figure in the centre represents the sac. Through its mouth a piece of glass rod is inserted; and although the sac is very small, it was remarkable for the layer of fat, *b*, between the peritonæum, *c*, which is not cut, and the fascia propria, *a*. (Museum Guy's Hospital, No. 477[c].)

Diagnostication; first, from other kinds of hernia. Those with which crural may may be confounded are inguinal above Poupart's ligament, and obturator below the horizontal ramus of the pubes. It would seem to be impossible, however, to mistake a crural hernia for an inguinal, or *vice versâ*, if the observer will but carefully trace the outline of Poupart's ligament. But he must remember that the fundus of the sac of a crural hernia sometimes takes a course upwards, and overlies that structure. Nevertheless, the course of Poupart's ligament can be always ascertained with more or less precision; whether an inguinal hernia overlies it from above —a very rare occurrence—or a crural from below, which is very common, the fingers of the examiner can still trace it from the ilium to the pubes—of course, in one case more distinctly than in another. If the whole of the tumour lies below the ligament, and its neck can be traced continuous with the crural aperture, its contents have escaped beneath Poupart's ligament, and it is a crural rupture; but if the contrary, it is an inguinal, especially too if the neck be traceable to the internal inguinal ring. Crural is distinguishable from inguino-labial hernia by placing the finger on the spine of the pubes, or upon the attachment of the tendon of the adductor longus into that point of bone; for even in very fat persons the pubic spine can be always felt. If the tumour be to its outer side, the protrusion has escaped below Poupart's ligament, in which case it is crural rupture; if, on the contrary, it has passed through the external inguinal ring, it must be an inguinal. The same point of bone will aid in distinguishing between a pudendal hernia and a crural.

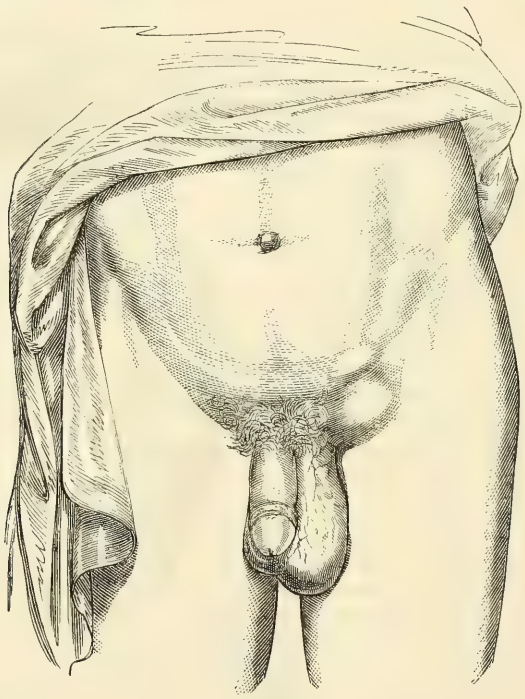
A crural hernia is much more superficially seated than an obturator, and in

consequence the tumour which the latter produces is neither so prominent nor so well defined as the former. The latter escapes from the pelvis behind the horizontal ramus of the pubes, and therefore Gimbernat's ligament and the crural aperture can be felt. The elevation of the integuments produced by an obturator hernia is certainly in the locality of the crural aperture; but the depth of the tumour is its striking feature, and the facility with which the crural aperture can be felt is pathognomonic of the relations of the protrusion.

Crural hernia requires to be distinguished from other diseases which occur in the same region.

1. From *psoas abscess.*—The history of the case, the locality of the swelling, and

FIG. 169.—Demonstrates the appearances produced by a small Inguinal Hernia just pointing at the External Inguinal Ring, and a medium-sized Femoral Hernia, both on the same side, and the outline of Poupart's Ligament between those tumours. On the left side of the scrotum a tumour is produced by hydrocele of the tunica vaginalis testis. (From nature, and copied from a drawing in Guy's Hospital Museum.)



the results of a palpable examination of the tumour, are quite different from hernia. Psoas abscess is generally preceded by pain in the back, constitutional disturbance, and inability to extend the hip-joint completely without pain. These symptoms do not accompany a crural hernia. Psoas abscess does not burrow down below Poupart's ligament at the crural ring, but to the outer side of the sheath of the femoral vessels. But an infallible test that the tumour is formed by a circumscribed collection of fluid is obtained by placing the patient flat on the back, and then gently applying the right hand above Poupart's ligament and the left below it, or *vice versâ*. When pressure is made upon the swelling with one hand only, the other is elevated; and when the action is reversed, the opposite effect takes place. With this result on manipulation of the swelling, there can be no doubt of the nature of the disease.

2. *Enlargement of the lymphatic glands.*—The correct history of the development of the swelling will aid in forming the diagnosis, especially its permanence and progressive increase. If there be a suspicion that the tumour is of glandular origin, it is as well to institute a careful examination of those somewhat secluded regions in which certain specific ulcerations unfortunately occur, giving rise to angioleucitis.

3. *Dilated and varicose veins.*—We have seen a dilated vein and a tumour formed of varicose veins occupying the site of a femoral hernia; but the diagnosis was easily made by placing the patient in the recumbent posture, when the swelling disappeared. Digital pressure being made at the crural ring or upon the vein, the swelling was at once reproduced.

4. *Cysts* in the superficial fascia. Cysts are sometimes, although very rarely, developed in the region of the crural ring, in some cases associated with hernia, but sometimes without. The permanency of the swelling, its persistent and invariable size, the fluctuation discoverable on pressure, and the history of the case, are aids to correct diagnostication. When a cyst is present, and there are any symptoms suggestive of strangulated bowel, the propriety of accurately ascertaining the contents of the tumour by an exploration of its interior cannot be disputed.

Palliative treatment.—The treatment of crural hernia by the use of trusses is most important. The prevention of the dilatation of the sac is the primary point to which attention should be directed; and this may be accomplished by giving support in the region of the crural ring, especially if it be efficiently maintained.

We gladly avail ourselves of the large experience of Mr. Kingdon in offering a few observations regarding the use of trusses in this variety of hernia. In a truss to prevent the escape of a crural hernia, the spring should fall somewhat suddenly from the point where it passes around the hip, and lie along Poupart's ligament. The pad should be rather small and convex. The cross-strap should fasten high up on the shoulder of the spring, in order to keep the pad well down in the thigh. The thigh-strap should start from near the pad, and return, after encircling the thigh, to the pad itself. When Poupart's ligament, or rather the whole crural arch, is lax, and moves backwards and forwards with the varying size of the abdomen, the pad should press upon that ligament; for then the crural aperture is made smaller, and the rupture more efficiently maintained. For that purpose a larger and flatter pad is wanted. But when the crural arch is strong and steady, the smaller pad is both more effective, and, by reason of its smallness, more convenient and less incommodious. Also, it is less liable to displacement by the movements of the hip-joint.

When the rupture is large, or where it comes down under the fascia lata, it is necessary to use a thigh-belt, with a triangular pad projecting on the inner surface, and forming a soft continuation of the pad, to fill the triangular space where the cribriform fascia occupies the saphenous opening of the fascia lata.

Sometimes after an operation, in which Gimbernat's ligament has been freely divided, a cross tongue in addition, to buckle to the free end of the truss, is needed.

Irreducible crural rupture of course requires a hollow pad, whether epiplocele purely, or enterocele.

Attempts have been made to effect a radical cure of crural rupture by a cutting operation. The patients recovered from its effects; but we have no data by which to arrive at any conclusion as regards the advantages obtained.

Crural hernia very rarely occurs before puberty. I have seen one in a girl ten years old.

Crural hernia is much more common in the female sex than in the male. But the general belief, that it is much more common in women than inguinal, does not appear to be founded on facts. The following table demonstrates the proportions in which they occur. The comparative numerical equality is explained by the circumstance, that before puberty inguinal hernia is common, whilst crural is extremely rare. In 193 girls before 15 years of age, Mr. Kingdon met with 184 cases of inguinal rupture, and only 9 of crural. Even to the age of 20 years, the cases of inguinal hernia are much more common than femoral, as the subjoined table shows. In a total of 1,442 ruptured females, at all ages from birth upwards, the majority of the cases of crural hernia over inguinal was only 54.

After twenty years of age, crural hernia is much more commonly developed than inguinal.

Decades	Inguinal	Femoral
Birth to 10 years	146	1
11 to 20 „	103	37
21 to 30 „	153	180
31 to 40 „	164	252
41 to 50 „	76	158
51 to 60 „	33	84
61 and upwards	19	36
Total	694 +	748 = 1,442 cases.[1]
Total cases of femoral		748
Deduct cases between 20 and 40 years		432
At all other ages		316
Deduct cases before 20 years of age		38
After 40 years of age		278

This table demonstrates a fact for which the pathologist will be scarcely prepared, viz. that the largest number of cases of crural hernia is developed during those years usually termed the prime of life, *i.e.* in women between twenty years old and forty.

But it must be observed that this happens to be that period of life when parturition is most frequent, and when consequently the peritonæum and the tissues of the abdominal walls become much stretched by the development of the gravid uterus. Their power to resist the weight of the abdominal viscera becomes diminished; hence a cause of their protrusion.

To ascertain whether there was any relation between the development of hernia and parturition, Mr. Kingdon made the following table of 680 ruptured females, and found the proportion of mothers to be as follows :[2]

	Inguinal	Femoral
Infants and girls under 16 years of age	87	3
Single women	50	61
Mothers	178	262
Married women who had not borne children	19	20
Total	334 +	346 = 680

And next, with a view to ascertain the influence of repeated pregnancies upon the development of hernia, he examined 442 women who had been mothers before discovering the hernia. Of these, 180 women were afflicted with inguinal, 262 with femoral; which gives a majority of 82 in favour of femoral.

The influence of the first pregnancy is very remarkable. 442 women had been mothers before discovering the hernia :

			Inguinal	Femoral
67	had borne	one child	27	40
51	„	two children	26	25
53	„	three „	22	31
55	„	four „	23	32
40	„	five „	15	25
25	„	six „	8	17
34	„	seven „	15	19
30	„	eight „	13	17
25	„	nine „	7	18
19	„	ten „	10	9
16	„	eleven „	5	11
8	„	twelve „	4	4
4	„	thirteen „	2	2
10	„	fourteen „	2	8
3	„	fifteen „	—	3
1	„	eighteen „	1	—
1	„	nineteen „	—	1
442			180 +	262 = 442

[1] This table was made from Mr. Kingdon's reports of the City of London Truss Society for the years 1860 and 1861. It shows the ages of the individuals at the time of first discovering the hernia. M. Malgaigne states that inguinal hernia is even more common in females than crural. *L'Union méd.* 1854, p. 154.

[2] *Report*, 1860, pp. 10, 11.

By a preceding table the fact was demonstrated that crural hernia is most commonly developed between twenty years of age and forty. Now as we know that there is a much larger number of females alive between twenty and forty years of age than above forty, we might conclude that the number of cases of crural hernia is in proportion to the numbers of the population at any respective age. Under twenty years of age this is certainly not the fact, for the population at those early ages of life is of course the largest, whilst cases of crural hernia are exceedingly rare. The cause of the frequency of inguinal hernia during the early life of females has been before explained (p. 815).

It is highly interesting to compare the frequency of crural hernia at various ages with the numbers of the female population of London at the same periods of life; and in this inquiry we have made use of the census-table of 1851,[1] and Mr. Kingdon's statistics before alluded to. From those data the subjoined table is arranged:

		Crural hernia
Females under 20 years	493,260	38
„ from 20 to 40 years . . .	453,809	432
„ „ 40 upwards	308,609	278
	1,255,678	748

This shows the number of cases of crural hernia in a million females—

Under 20 years to be	77
Between 20 and 40	952
Above 40	901

Doubtless this calculation can only be considered as approximating to numerical accuracy; but it seems to demonstrate the truth of the general proposition, that females between the ages of twenty and forty years are most liable to the development of crural hernia under certain conditions. The cause of this liability is probably due to the natural condition before alluded to, coupled with its attendant circumstances, and the occupations of the class of persons which would apply to public charities; as well as, perhaps, to configuration, and some predisposing causes, or hereditary influences.

Morbid states of the crural hernia.—An irreducible crural epiplocele is very often seen; an enterocele in the same state is very rare. With a view to ascertain whether the strangulation of the bowel was in any degree influenced by the accompaniment or absence of omentum, we made an analysis of sixty-one cases of strangulated crural hernia, which came immediately under our own care for operation. The proportions were equal; there being thirty-one pure enteroceles, thirty entero-epiploceles.

A reducible crural epiplocele may at any time become inflamed, give rise to local pain, and increase in size. The local application of cold, and absolute rest, are the measures to be employed to prevent adhesion between the rupture and its sac. This condition of an omental rupture in the groin is sometimes mistaken for angioleucitis. But the history of the case, and the negative evidence derived from the absence of every primary cause of lymphatic irritation, should suffice to remove all difficulty in diagnosis.

Both Pott and Astley Cooper allude to circumstances which are of vital importance in the treatment of crural hernia, viz. the difficulty often experienced in the reduction of small recently-developed enteroceles, the rapidly extending injury of the bowel, and the severity of the constitutional symptoms which are excited by that condition. But these features have been more fully insisted on by Mr. Bryant in a careful investigation of the cases admitted into Guy's Hospital.[2] Out of 142 cases of strangulated crural hernia, only 38 were reducible by the taxis. This, of course, is explicable by remembering that the majority of such cases is not sent to the hospital until the further use of the taxis is evidently unjustifiable. Ten of these cases were of recent development, that is, they were strangulated on their first recognised descent. This is an important feature in crural hernia, bearing especially on the results of treatment in these cases. It is cases of this kind which are so frequently over-

[1] Census, 1851, vol. i. p. 193, table ii.

[2] *Guy's Hospital Reports*, 1861.

looked by the medical attendant. He suspects that the symptoms exhibited by the patient are referable to a rupture, and he asks the question whether there is any tumour to be felt in the groin or elsewhere. Receiving a negative reply, he is content therewith. But that should not satisfy him. The surgeon should carefully examine the crural rings and the other regions in which a hernial tumour may exist.

The mortality arising in cases of strangulated crural hernia of all kinds is very large; but in those where the bowel becomes strangulated on the first descent, the death-rate is the largest. The experience of a large number of these cases teaches that the bowel should be liberated as soon as possible, and, if the taxis be not successful when the patient is fully under the influence of chloroform, that the cutting operation should not be delayed a moment.

The youngest girl we have heard of suffering with strangulated crural hernia was between eight and nine years old.

Application of the taxis.—The patient should lie on the back, with the hip-joint more or less flexed. The surgeon, taking a position most convenient for the purpose, gently compresses the whole swelling, at first endeavours to diminish its size by pressing any serous effusion that may happen to be in the sac into the abdomen, and next to empty the bowel of its contents. Then, recalling to mind the site of the crural ring, he presses the bowel backwards, inwards, and upwards.

The operation of liberating the strangulated bowel by incision.—The tissues to be divided to expose the sac are the integuments, the superficial fascia, the fascia propria, and often a layer or covering of fat. The points to be particularly observed as guides for the safe and certain manipulation of the sac are, first, Poupart's ligament in front and above it; and, secondly, Gimbernat's ligament at the pubic border of its neck.

Slight variation in the line, direction, or figure of the incision through the integuments is admissible, according to the inclination of the operator; but for all practical purposes we prefer a linear incision of from two or three inches in length. It should cross over the pubic side of the neck of the tumour, and extend on to the abdomen about one inch above Poupart's ligament. Its form being slightly concave, the neck of the tumour is embraced by the concavity. The integuments and superficial fascia being divided, a well-defined, membranous sac is usually seen, and the operator should next display clearly Poupart's ligament above the tumour, and feel Gimbernat's ligament to the pubic side of its neck. This covering is the fascia propria. Next, he may pass a hernia bistoury, with great care, between the last-named ligament and neck of the tumour, outside the fascia propria, and, directing its sharp edge upwards, cut a few of the fibres of Gimbernat's ligament, or of those which unite the falciform process of the fascia lata to it (Hey's ligament), and thus enlarge the crural ring. This done, the reduction of the rupture may sometimes be effected by the application of gentle pressure upon the contents of the sac. This proceeding constitutes the minor operation. It is simple, safe, and well adapted to cases of recent enteroceles which have been strangulated a very few hours, and when there is reason to believe that the bowel has escaped injury by the taxis. Obviously, therefore, it is only justifiable in select cases.

Failing to reduce the contents of the sac, the fascia propria is next carefully divided upon a grooved director, and a layer of fat is very frequently exposed. Inexperienced operators, mistaking this fat for the omentum, are puzzled when they cannot find the bowel, or they mistake the peritoneal sac for intestine when that is seen upon clearing away the fat. The hernial sac being exposed, it should be traced upwards to the crural ring, and the fascia surrounding it in the crural canal divided; or the division of the structures forming the crural canal having been reserved for this special moment, must now be undertaken, as before described. But the hernia remains irreducible. With great care, and *secundum artem* (p. 783), the sac must now be incised. Through the first puncture a stream of serum usually flows. Empty the sac of the fluid by enlarging the opening sufficiently to reach its orifice. If nothing but omentum be seen, carefully raise it from below or gently unravel it, and towards the mouth of the sac, secreted behind that part of the omentum which has just escaped through its mouth, the bowel will be seen. Next, to enlarge the

orifice of the sac, introduce the point of the finger between the protrusion and Gimbernat's ligament; but if that cannot be done, the hernia bistoury must be insinuated in front of the omentum, directing its cutting edge forwards and holding the blade parallel with the linea alba. Having then liberated the bowel from its constriction, it is easily returned into the abdominal cavity. It is not always necessary to cut the orifice of the sac, after having divided the tissues outside of it, as before described. Its tissues frequently yield before the gentle introduction of the finger.

Arrange the wound in such a manner that an opening exists at the lowermost angle for the escape of discharge, and flex the hip-joint by placing a pillow beneath the popliteal region for the limb to rest upon. Any further special detail for the treatment of the case is here unnecessary.

Mr. Kingdon has informed us that the extent to which Gimbernat's ligament is divided is a subject of grave importance as regards the future comfort of the patient. He states that Hey's ligament should rather be cut than Gimbernat's, and that when the latter is at all extensively divided, it is almost impossible to retain the hernia after the thickening, subsequent to the operation, has passed off. Certainly the most prodigious crural hernial tumours we have seen occurred in women upon whom an operation had been performed for strangulated bowel.

Arteries, cut during the progress of the operation, should be immediately twisted.

Wounds of the obturator artery.—This blood-vessel, when it passes to the obturator canal, after dividing from the internal epigastric or femoral, lies close to the neck of the sac, and it has been occasionally cut at the same moment as its orifice. Before using the knife, it might be practicable to feel the pulsations of this artery with the tip of the finger. When cut, an attempt should be made to arrest the bleeding by twisting the ends of the wounded vessel. See Mr. Spence's case, p. 818.

Omental sacs are most commonly met with in cases of crural hernia. An account of them has been given at pp. 783-4.

Obturator hernia.—The obturator canal is situated at the upper and outer part of the obturator or thyroid foramen, and is bounded above by the horizontal ramus of the pubes, and in other parts by the obturator membrane or ligament and the obturator muscles, which are attached to its internal and external surfaces. The muscle within the pelvis is covered by the internal abdominal fascia, that outside by the obturator fascia. The obturator nerve, artery, and vein pass through the canal from the pelvis to the thigh. The course of the cutaneous filaments of this nerve should be especially noticed; for as its trunk is in close proximity to the hernial tumour, the pressure which the latter makes against it induces pain in those regions where the filaments of the nerves are distributed. In some cases this fact may prove a valuable aid in diagnosis, as the sequel will show.

This rare variety is described as hernia through the obturator canal, the foramen ovale, the thyroid or obturator foramen, and sub-pubic femoral. In the early part of the last century M. Garengeot[1] called the attention of surgeons to this kind of hernia, which, after having escaped from the pelvis through the obturator canal, forms a swelling among the adductor muscles and in the pubic region of the thigh. The neck of the sac lies behind the horizontal ramus of the pubes, occupies the obturator canal, and makes its way sometimes between the uppermost fibres of the external obturator muscle, at other times above them. The fundus and body of the sac are covered by the fascia of that muscle. By the dissections of several cases, the obturator vessels and nerve are shown to be differently placed as regards the tumour. Vinson[2] states that he found the artery six times to the outer side of the sac, six times to the inner side, and three times behind it. The relative position of this artery to the sac probably bears some relation to its origin. In Mr. Stanley's case,[3]

[1] *Mém. de l'Acad. roy. de Chir.* t. i. part iii.
[2] Günther's *Lehre v. d. blutigen Operationen*, Abschnitt xv. § 146.
[3] *Trans. of the Path. Society*, vol. iii. p. 94.

both artery and nerve were above the hernial sac; the former to its inner side, the latter towards its outer.

Both sexes are liable to the formation of this hernia, but a large majority of the cases on record occurred in females. The anatomical reasons for this are obvious.

There are cases on record in which this hernia had existed, and in which the viscus was strangulated without any local signs of a tumour. Mr. Hilton's case,[1] in which the entire calibre of the ileum was in the sac; and Mr. Tebay's,[2] in which only a part was found, are marked illustrations. In Mr. Obré's case,[3] 'the eye detected a slight degree of fulness in Scarpa's triangle,' and 'a distinct hardness could be felt, slight in its extent.' In the only instance we have seen, the hernia gave rise to a very distinct, well-defined tumour, deeply seated among the adductor muscles, to the pubic side of the femoral vessels. In Mr. Stanley's case,[4] a crural epiplocele existed on the same side as the obturator entero-epiplocele. The latter was, however, extremely small, and produced 'no swelling on the inside of the thigh.' The hernia 'was found with its peritoneal sac beneath the obturator externus muscle, between the muscle and the obturator fascia.'

The foregoing observations illustrate the difficulties which attend the detection of protrusions through the obturator canal.

We have collected twenty-five of the most recently recorded cases of this variety of hernia, and the remarkable features they present are well worthy the attention of the reader. They may be divided into two classes: the first embraces a large majority, and consists of those cases in which the hernial tumour was not discovered during life; the second, those in which it was discovered by palpable examination, either immediately at the inner side of the thigh, or, as in one instance, only by an examination per vaginam.

In several of the cases of the first class, the tumour produced by the protrusion was so small, that the sac, with its contents, being placed deeply among the adductor muscles and beneath the pectineus muscle, could not give rise to any local external swelling. In two cases the tumour was found between the obturator ligament and obturator externus muscle. The contents of the sac in six cases consisted of only a portion of the calibre of the canal of the intestine. This had, however, become converted into a diverticulum, in some instances of considerable length. We meet with this condition of the hernia occasionally in other regions, but the cases are not common; and we may therefore conclude that, in proportion to the rarity of obturator hernia, this may be considered to be one of its remarkable features. In one case, the Fallopian tube and ovary formed the contents of the sac; in another, a portion of the urinary bladder.

The hernial sac, which is never wanting, consisted always of a portion of the parietal peritonæum of the pelvis thrust through the canal, and tolerably firmly attached to the parts with which it was in contact. The sac was therefore slowly formed. On this account some of the patients had experienced, during the development of the hernia, repeated attacks of bowel derangement, evidenced by symptoms of obstruction, termed colic pains, uneasiness at the inner and upper part of the thigh, and even cramp or spasmodic pains in the muscles of the femoral region, and which extended down the leg.

In a large number of the cases, the acute pain in the course of the obturator nerve, described by the patient, was a marked feature of the case, and pressure over the site of the external aperture of the obturator canal gave rise to paroxysms of pain of great severity. It is due to the tact of Mr. Howship[5] to state, that he seems to have been the first writer to dwell particularly upon this fact, which some years afterwards was strongly insisted upon by Romberg.[6] The only patient we have seen with this variety of hernia complained bitterly of feeling a sudden pain at the upper

[1] *Med.-Chir. Trans.* vol. xxxi. p. 323. [2] *Med. Times and Gaz.* vol. ii. p. 270, 1852.
[3] *Med.-Chir. Trans.* vol. xxxiv. p. 233. [4] *Trans. of the Path. Society*, vol. iii. p. 94.
[5] Howship's *Practical Remarks on the Discrimination and Appearances of Surgical Disease*, 1840, p. 323. Prep. in Mus. Coll. Surg., No. 1359.
[6] Romberg, in Dieffenbach's *Operative Chirurgie*, b. ii. p. 621. 8vo. Leipzig, 1848.

and inner part of the right thigh, which extended thence down the inside of the limb to the knee, front of the leg, foot, and great toe.

The cases of the second class are those in which the tumour was discovered during life, either in consequence of its bulk, or by a careful examination of the region in which it was developed.

Dr. Roeser[1] proposed that advantage should be taken of the rectal passage of the male, and the vaginal of the female, to institute a more searching examination of the obturator region within the pelvis; and by this means Dr. Lorinser, in 1857, discovered an obturator hernia.[2] Dr. Nuttall, of Leicester, in the same year, in a case in which not even fulness of the adductor fossa was perceptible, was induced, by the severity of the constitutional symptoms of strangulated bowel, and the pain caused by local pressure made directly upon the obturator region, to explore that part; and his judicious treatment was rewarded by the discovery of a very small hernial tumour, the contents of which were returned into the abdominal cavity by gentle pressure, without incision of the sac.[3] Before this Mr. Obré had successfully operated upon a case of strangulated obturator hernia in 1851, in which 'the eye detected a slight degree of fulness in Scarpa's triangle, on the right side;' this triangle of the opposite limb being well marked with a hollow or depression passing down its centre, but which was lost on the affected side. Also, on pressing firmly 'a little below the saphenous opening, a distinct hardness could be felt.' Lastly, in the case successively operated upon by Mr. B. B. Cooper, in 1853, the woman being very thin, there was both ocular and palpable evidence of an indisputable nature. At first sight, the swelling in Scarpa's triangle seemed to be identical with that which might be produced by a protrusion through the crural canal; although it had not the appearance of being in close relation with Poupart's ligament, for it formed a somewhat globular fulness, rather than a circumscribed tumour. Then the point of the finger could be placed in the crural ring, which, of course, was conclusive evidence that the hernia had not escaped through it. Really, therefore, there were no practical difficulties to prevent the formation of a correct diagnostication in this case. We may here state that these observations are made from notes of the case taken personally at the bedside of the patient.

Complications.—But we must allude to a class of cases, of which there have been several instances, in which the existence of an obturator hernia was complicated with the development of other kinds, especially those in the inguino-femoral regions. In one case there was a reducible crural hernia on either side; in three cases, a crural hernia on the same side as the obturator; in one case, on the opposite side; and in another case, an inguinal hernia on the same side as the obturator.

The treatment adopted in three of these cases was that which most surgeons would approve. The symptoms of strangulated intestine being clearly marked, an exploration was made of the hernial sacs, which were visible and tangible, in the expectation of finding a small knuckle of bowel retained within them. But nothing of the kind being found, the examination was not prosecuted further; although, in two of the cases, an obturator hernia, seated immediately beneath the site of the operation, was proved, by after-death examination, to have been the cause of death.

As a possible complication, we must here allude to the fact that in some of the cases, in the same individual, a sac was found to pass through both right and left obturator canals.

In fourteen of the cases the obturator hernia was not discovered until after death. In one case the symptoms indicated the existence of this variety of hernia, and the patient recovered without any interference on the part of the surgeon. In ten of the other cases the protrusion through the obturator canal was discovered during life; and the treatment adopted and its results we may briefly describe. In one case the protrusion was reduced after the application of the taxis by Dr. Roeser, of Bartenstein. This was in a female 30 years of age, rather corpulent, who had been frequently troubled with intestinal disturbance. By careful manipulation a small tumour was felt over the external aperture of the left obturator canal, upon which pressure caused great pain.[4] In another case Dr. Roeser was not so successful in the treatment. This was a male 50 years old, who had been frequently troubled with pains in the abdomen, called colic. The case was rendered obscure by enlargement of the inguinal glands on the same side as the hernia; nevertheless Dr. Roeser diagnosticated the obturator rupture and partially reduced it. The man, however, died, and after death a part only of the wall of the intestinal tube was found in the sac.[5]

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[1] *Archiv f. phys. Heilkunde*, 1851, p. 142 *et seq.*
[2] *Lehre v. blutigen Operationen*, Abschnitt xv. § 147.
[3] *British Medical Journal*, p. 566, 1857.
[4] *Archiv f. phys. Heilkunde*, 1846, § 408.
[5] Ibid. 1851, § 142.

In one case the obturator hernia was discovered during life after the performance of gastrotomy.[1] Dr. Arntz saw a woman 62 years old when she had been suffering three weeks. He discovered and diagnosticated an obturator hernia, the integuments over which were inflamed and becoming gangrenous. He made an incision; the contents of the tumour escaped; and the patient died next day.[2] The accuracy of the diagnosis was verified after death.

Dr. Heiberg operated upon a woman, 50 years old, after distinctly feeling an elastic swelling in the left adductor region. Upon this tumour he cut down, opened the hernial sac, stretched the obturator canal with his finger, and returned the bowel. The patient, however, died.[3] Mr. Heath, of Newcastle, operated upon a woman 75 years old. The tumour, although small, was perceptible; the pain on pressure and down the limb very characteristic. The aged patient survived the operation thirty-six hours, and the commencement of the attack about four days.[4] Dr. Nuttall, of Leicester, being called to a woman, aged 75 years, suffering with well-marked indications of strangulated intestine, but without any tumour in the usual site of hernial protrusions, was led, in consequence of pain being produced in that part when he pressed in one particular spot, to diagnosticate an obturator hernia, although there was not even 'fulness' perceptible, over the site of the obturator region. He cut over this painful spot, found a small tumour, exposed the hernial sac, and reduced its contents by gentle pressure. This old woman survived thirteen days. After death the bowel which had been strangulated was found in process of repair. An obturator hernial sac was seen on both sides.[5]

We have now to describe the cases which have been cured by operation. The late Mr. Obré, of London, was the first surgeon to cure a case of strangulated obturator hernia. This was in 1851. In a woman, aged 55 years, tall and stout, he diagnosticated this hernia. He cut down upon the swelling, incised the sac and its orifice slightly, and returned a small piece of blue congested bowel.[6]

In 1853 I assisted Mr. Bransby Cooper in an operation he performed at Guy's Hospital on a woman, 49 years old. She was exceedingly emaciated, had given birth to twelve children, and was affected with bronchitis. She was not aware of being ruptured. For sixty-two hours before coming to the hospital she had been suffering with strangulated intestine. Her illness began with a sudden pain at the upper and inner part of the right thigh, and extended from that spot along the inside of the thigh, knee, front of leg, and to the great toe. Upon examination of the region below Gimbernat's ligament, a deeply-seated swelling was felt. Mr. Cooper made an incision over the tumour, divided the pectineus muscle, and reached the hernial sac. Gentle pressure was made upon it, and the contents passed readily into the abdomen. She slowly recovered, and the wound entirely healed; but before she left the hospital she was seized with acute bronchitis, which caused her death.

Dr. Lorinser, in 1857, discovered an obturator hernia by an examination per vaginam. The age of the patient is not stated. On the eleventh day after the commencement of the attack, he cut down upon the tumour, opened the sac, and found the contents in a state of gangrene. A fæcal fistula was established, which subsequently closed, and the woman survived the operation eleven months.[7]

We have now given a brief but instructive summary of the cases on record from which useful practical lessons may be derived. There are more instances published, which have been discovered after death, and therefore simply attest the fact of the existence of the disease.

Mr. Kingdon believes he has met with five cases of obturator hernia in living persons. Two of them were in men; in both the femoral artery was in front of the swelling, and pushed forwards at each forced expiration. The men were past forty years of age, thin and gaunt. He does not recollect whether the femoral artery was pushed forward in the female, whose case he otherwise well remembers, but he distinctly recollects that he was able to feel the bony rim at the upper edge of the aperture, through which he had returned the hernia. The woman was emaciated to the last degree of voluntary locomotion.

We propose next to select the most prominent facts from the whole number of cases, with an especial view to the diagnostication of those cases in which there may not be any palpable or ocular evidence of a rupture.

Diagnostication of an obturator hernia—from its position. After passing along the obturator canal, it emerges upon the thigh below the horizontal ramus of the pubes, to the inner side of the capsule of the hip-joint; behind, and a little to the inner side of the femoral artery and vein; and to the outer side of the tendon of the adductor longus. The tumour formed by the protrusion is covered by the pectineus muscle. From crural hernia, therefore, it may be distinguished by observing the

[1] Mr. Hilton, *Med.-Chir. Trans.* 1848, vol. xxxi. p. 323.
[2] Günther's *Lehre v. d. blutigen Operationen*, Abschnitt xv. § 148. [3] Ibid.
[4] *Lancet*, 1857, vol. ii. p. 109. [5] *Brit. Med. Journal*, 1857, p. 566.
[6] *Med.-Chir. Trans.* 1851, vol. xxxiv. p. 233.
[7] Günther's *Lehre v. d. blutigen Operationen*, Abschnitt xv. § 147.

relative positions of the horizontal ramus of the pubes and of the femoral artery. Those structures occupy, in fact, a position between these two kinds of hernia. In obturator hernia they are in front of the tumour; in crural hernia they are behind it. In the former, then, they are easily felt; in the latter they cannot be without difficulty—not, perhaps, until the hernia be reduced. In those cases in which either a fulness, slight hardness, tumefaction, or swelling exists, coupled with well-marked indications of obstruction or strangulation in some part of the alimentary tube, the difficulty of diagnosis is not so very great; but how much embarrassment arises when those symptoms which betoken strangulated bowel exist, and a tumour is nowhere to be felt, let the numerous cases on record attest, in which the rupture has only been found after death.

Assuming, for the sake of illustration, that we have before us a patient suffering with well-marked constitutional indications of strangulated bowel, and that, after the most careful examination of all those apertures through which ruptures more commonly escape, we have failed to detect any palpable tumour to assist in explaining them, how are we to discover an obturator protrusion, or obtain sufficient evidence of the probable existence of one to justify an exploration of the obturator region by means of the scalpel? We reply, By pain during the development of the hernia; by pain at the commencement of the present attack; by pain of a peculiar character during the progress of the illness; by pain referred to the course of the cutaneous filaments of the obturator nerve and the plexus formed with it, and the internal cutaneous and its distributions; by pain excited by certain definite movements of the hip-joint; by pain induced by local pressure carefully applied; and by pain when an examination of the pelvic orifice of the obturator canal is made per vaginam.

We shall now describe these important indications with a little more precision. During the formation of the hernia, some of the patients had suffered at irregular intervals with constipation, nausea, and pain resembling colic in the pelvic region; and one woman related how upon repeated occasions she had suffered thus, and felt relieved directly after experiencing a sensation as if something slipped back into the abdomen at the lower part. In Mr. Hilton's case, some months before the fatal attack from hernia on the left side, the patient had suffered with symptoms of bowel-obstruction and pain referred to the right side. After death a right obturator hernial sac was found, 'more distinct than on the left side, large enough to admit freely the forefinger.'

One patient narrated, in a very striking manner, how she had been suddenly seized with a violent pain at the inner and upper part of the thigh. Soon afterwards, nausea, followed by vomiting and all the other indications of strangulated bowel, existed.

In several of the cases there appears to have been something very characteristic in the nature of the pain. Admitting the difficulty of meeting with any two or more persons who would describe pain so closely resembling each other's sensations as to prove an infallible guide, yet that described during the progress of the illness seems to afford some clue in these cases. It is described as spasmodic contraction of the abdominal muscles, and not as pain within the abdomen. For the explanation of this phenomenon, we may refer to the association existing between the cutaneous filaments of the obturator nerve, which are irritated by the pressure of the tumour in the obturator canal, and the muscular filaments distributed in the abdominal muscles; for all are branches of the lumbar plexus.

The pain described by several patients, in both instances, when a hernial tumour was palpable, as well as when it was entirely concealed, could not have failed to attract the notice of the surgeon to the distribution to the cutaneous filaments of the obturator nerve, and the more internal of the internal cutaneous. In this fact we have a most valuable aid to the diagnosis of some abnormal pressure upon its trunk, as it traverses the obturator canal. Certain definite movements of the hip-joint may subserve very usefully in diagnostication, as, for example, when there may be some doubt on which side the protrusion exists, or when it chances to be so small as to be under the influence of the obturator muscles, when only in a violently contracted

state. We may therefore employ the actions of these rotators of the femur outwards, to compress the tumour, and thus excite pain; and by comparing the influence of these muscles on both sides of the pelvis, valuable aid might be obtained. It has been demonstrated after death, that in some cases the protrusion passes between the fibres of the external obturator; and therefore we may suppose that they could readily compress the neck of the tumour. Want of space prevents further detail; we must therefore leave the adoption of this test, and the method of employing it, to the intelligence of the surgeon.

In several cases, the effect of local pressure over the external outlet of the obturator canal has been to cause acute pain, and even the detection of slight fulness or hardness when no other sign existed at the site of the protrusion. But even this examination should be made with great discrimination. A careful distinction must be made between pain caused by pressure on the obturator nerve and on a hernial protrusion; the muscles, especially the pectineus, must be relaxed; and a comparison of the results of the same amount of pressure on the two sides of the body in the same locality should be instituted with proper precautions. The femur should be supported by an assistant in a position of slight flexion, with rotation outwards, and between abduction and adduction.

The pelvic aperture of the obturator canal may be reached from the vagina in the female, and from the rectum in the male. In cases of difficulty and doubt, therefore, some assistance may be gained by taking advantage of the opportunities these passages afford for the necessary examination.

Accuracy in diagnosis being of paramount importance, we cannot conclude this part of the subject without alluding to the great advantage to be derived from carefully comparing the outline of Scarpa's triangle on both sides of the body; and of impressing upon those who may happen to have a case of suspected obturator hernia under examination, the practical value of seriously reflecting upon all the features of the case referable to nervous derangements, as aids to diagnosis in these most perplexing and difficult cases.

Treatment.—Should a hernia be detected, the application of pressure to the tumour may succeed in reducing it. The pressure should be directed in such a manner as to free the hernia from the ramus of the pubes, and pass it underneath it.

Failing to do this, or even with a well-grounded suspicion of hernia, the surgeon should explore the region below Poupart's ligament. The incision through the integuments should be either parallel with the trunk of the femoral artery, or with the fibres of the adductor longus muscle. It must be sufficiently far inside the artery to avoid the femoral vein. It may commence a little above Poupart's ligament, at a point midway between the spine of the pubes and the spot where the femoral artery passes over the ramus of that bone. The fascia covering the pectineus muscle being exposed, perhaps the hernial tumour may be felt; and if not, pain on local pressure may incite to a deeper prosecution of the search. This fascia and the pectineus muscle being divided in the line of the original incision, or its fibres being separated with the handle of the scalpel, some fat and the fascia of the obturator muscle are reached. As yet, however, the tumour has not been felt; nevertheless it may still be there, under cover of the fibres of the obturator muscle. These must be separated; for it is not until the finger can be placed upon the outlet of the obturator canal that the search for the hernia should be abandoned as hopeless. Care must be taken to avoid cutting the filaments of the obturator nerve.

How far the surgeon would be justified in making an examination of the opposite side, after having failed to find the hernia on the one first explored, is a proposition we must leave to the judgment of those who may happen to be placed in such an unpleasant dilemma.

We conclude with this observation of Camper: 'Forsan frequentiores sunt, quam quidem creditur; in ilio igitur ad omnis generis herniarum possibilitatem necessario attendendum est.'

Perineal hernia.—The sac of this hernia is formed of the peritonæum, which in the male lies between the prostate gland and rectum, and in the female between the vagina and rectum. In both sexes, when the hernia fills the sac, there is a tumour in the perinæum. This kind of hernia is most common in women, and usually consists of a portion of the alimentary canal, of the omentum, or of the urinary bladder.

The sac of a perineal hernia escapes between the anterior fibres of the levatores ani, and is covered by the internal abdominal fascia of that region of the pelvis.

The protrusion of the hernia may be prevented by using a T-shaped bandage.

Pudendal hernia.—Pudendal hernia forms a small elastic tumour in the labium pudendi. It lies in the posterior and inferior half of that organ, and forms a somewhat elongated projection at the side of the vagina. The neck of the sac is placed between the ascending ramus of the ischium on the outside, and the vagina on the inside.

This hernia may be developed at the age of 22 years (Sir A. Cooper); and in this case it had existed some months.

The tumours in the labium, which may be confused with this hernia, are those formed by inguinal protrusions and collections of fluid. Of the last are cystic formations and hydrocele of the round ligament. These, however, are never reducible; they are not diminished by pressure, and they slowly increase in size from their first appearance.

From inguinal hernia it is distinguished by its position, shape, and relations. It has not passed through the external inguinal ring, but lies parallel with the axis of the vagina. It does not form a pyriform tumour in the labium, but a somewhat rounded mass. It lies by the side of the ramus of the ischium, and not over the body of the pubes.

From crural hernia it is distinguished by the neck of the tumour being placed entirely to the inside of the ramus of the ischium, and the muscles attached thereto.

A suitable bandage is required to support the protrusion.

Vaginal hernia.—This hernia is usually developed in women who have borne several children. It is only covered by the peritonæum, and that portion of the walls of the vagina which protrudes. The orifice of the sac is usually large, and readily yields to pressure. Consequently it is easily reduced, and, with the exception of the discomfort and annoyance it causes, it is not attended with urgent symptoms. The rectum and urethra may, however, become so much compressed, that inconvenience and sometimes suffering may arise from this cause.

The protrusion requires to be replaced in the pelvis, and the necessary support to maintain it there is afforded by making use of a suitable bandage.

When the urinary bladder forms the rupture, which occasionally happens, great distress arises from a constant desire to micturate. The urine becomes ammoniacal, and the bladder so irritable, that a few drops of urine, constantly escaping, cause intolerable inconvenience. Treatment is therefore urgently required to improve the condition of this secretion, and to empty the bladder, whilst the rupture must be at the same time supported.

Ischiatic hernia.—This kind of hernia escapes through the ischiatic notch, and forms a tumour beneath the glutæus maximus muscle. The neck of the sac is either above or below the pyriformis muscle, but generally below it. The fundus, at first covered by the glutæus muscle, as it extends further out of the pelvis, escapes below the edge of that muscle, and lies under the integuments.

When the hernia is in the sac, it forms a tumour of variable size, soft, tense, yielding, reducible on pressure, and causing more or less pain.

Should the hernia become strangulated, and the operator be required to enlarge the mouth of the sac, Sir A. Cooper advises that the incision be carried directly forwards.

JOHN BIRKETT.

DISEASES OF THE RECTUM.

IN the following essay on Diseases of the Rectum I have treated the subjects in the order of their frequency and importance: Hæmorrhoids; Prolapsus; Fistula; Ulcer; Stricture; Cancer; Polypus; Pruritus; and Neuralgia. Nothing has been said in reference to malformations of the anus and rectum, as this subject is considered in the essay on the SURGERY OF CHILDHOOD.

HÆMORRHOIDS.

It has been the custom of surgical writers, when describing hæmorrhoids, to divide them into two distinct kinds, namely, external and internal. This is a classification from which it is perhaps not well to deviate; for, although many instances are seen where it is impossible to say whether the disease be internal or external—and, pathologically speaking, hæmorrhoidal tumours, wherever situated, are essentially constituted of the same morbid elements, viz. an enlargement of the vessels of the rectum, and an infiltration of their connecting tissues—still circumstances which exist, or which occur, in connection with this disorder so modify the pathological features, that in numerous instances there is a wide and well-marked distinction between those hæmorrhoidal tumours seated outside, and those involving the gut within the sphincter.

I shall therefore adhere to the classification, and first speak of

External hæmorrhoids, which are situated at the verge of the anus outside the sphincter, and consist of one or more tumours, composed at their first formation of dilated vessels. As the disease increases, from various irritating causes, the sensitive skin around the anus becomes thickened, the cellular tissue is indurated and infiltrated, and the veins are expanded. By degrees the swelling becomes larger and harder, and does not give much annoyance when the parts are in a quiescent state; if, however, they become attacked with inflammation, the tumour increases much in size, the blood in the vein becomes coagulated, and not unfrequently the vessel gives way, allowing the coagulated blood to escape into the surrounding cellular tissue, where it will form a distinct sheath for itself. In the course of time the inflammatory action subsides, the blood becomes absorbed, and the tumour diminishes in size, or wholly disappears. If, however, the same irritating causes recur, and no effectual treatment be adopted, the tumour again increases, the skin becomes thickened, and the cellular tissue more extensively infiltrated; and in this way distinct and permanent tumours are formed around the anus, which sometimes reach a large size, consisting mainly of thickened integument and cellular tissue enclosing veins which are at times capable of distension and repletion. In their quiet state these tumours are distinctly external; but when increased in size they may encroach upon the cavity of the rectum and be covered with mucous membrane and thus be partly internal. Coexistent with this state there is not unfrequently a very œdematous condition of the cellular tissue and mucous membrane at the verge of the anus.

With regard to the actual structure of these hæmorrhoidal tumours, it will be found on examination that they are composed of thickened integument, infiltrated cellular tissue, and in most cases of one or more dilated veins; if the part is at perfect rest and has not been lately inflamed, there may be distinguished nothing beyond infiltrated tissue and thickened skin; but on cutting into an external pile which has been somewhat irritated, or is increasing in size, there will be found either a vein considerably dilated and containing semi-coagulated blood, or the blood will have escaped from the vessel, and have become either extravasated into the

surrounding cellular tissue, or have formed for itself distinct cellular sheaths. This coagulation of the blood is the reason why an incision into an external hæmorrhoidal tumour, after having become inflamed and swollen, is scarcely ever attended with bleeding, and it is one of the main pathological features in this form of tumour, and far different from what obtains in instances of the internal affection.

These external hæmorrhoids vary much in size, the swellings being sometimes not larger than peas, while at other times they are the size of a walnut. Their presence is accompanied with unpleasant symptoms : as irritation ; pain when at the closet ; and a sense of bearing down, even when they are in a quiescent state ; but the main source of suffering is their disposition to become suddenly enlarged and inflamed ; which occurrence will arise from allowing the bowels to become constipated, from the straining attendant upon a stricture of the urethra, from excess in food and drink, or from exposure to damp and cold. Under these circumstances, the tumour, which has been hitherto small and flaccid, becomes much swollen, distended, and livid in colour. From the peculiarly sensitive character of the skin at the anus, this distension is accompanied with the most exquisite pain ; and it is remarkable to witness the complete prostration with which the most powerful man is overcome when suffering from acute inflammation of external piles, and especially when the symptoms have been allowed to go on for some days without the proper means of relief being afforded, either from obstinacy on the part of the patient, or from insufficient pathological knowledge on the part of the medical attendant.

With regard to the causes which produce this form of hæmorrhoids, there is every reason to believe that the same circumstances which tend to the production of external, induce the internal affection as well ; and therefore this description will apply to both. It appears that there is in some persons an hereditary disposition to hæmorrhoidal affections ; and we shall every now and then see father and son, or mother and daughter, suffering one after the other in the same way. Possibly, however, this may be owing to similarity in habits, certain of which undoubtedly much more than others induce these affections. Thus, those who have to sit continually at the desk, and take little walking exercise, are very liable to them ; those, too, who have to stand long in certain positions, as dentists and hairdressers, are remarkably prone to hæmorrhoids. The great source of hæmorrhoidal affections, however, is anything which prevents the healthy return of the blood from the vessels of the rectum. And thus it is that congestion of the liver, or other obstructive disease of the same viscus, is frequently associated with these affections. A constipated state of the bowels, both from the mechanical effect produced upon the vessels, and from the straining efforts necessary, is found to be the cause in a vast number of cases ; the pressure also of the pregnant womb, and of ovarian tumours, produces hæmorrhoids. In other cases, the irritation caused by the frequent taking of aperient medicines is reasonably considered to be productive of the first symptoms of the disease. Violent horse-exercise, indulgence in the use of highly-seasoned dishes, and other indigestible food and strong wines, together with immoderate sexual intercourse, which determines the blood more freely to the pelvic region, are each fertile sources of hæmorrhoidal affections. And it is highly necessary, before any treatment is commenced, to inquire carefully into the peculiar habits of the patient.

The treatment which should be adopted for the removal of this affection must be conducted upon the ordinary principles of surgery. In the more simple cases, little beyond a strict attention to ablution, to the regular action of the bowels, and to the avoidance of those causes which are known to produce the affection, will be necessary. If there be much irritation about the anus, an occasional dose of calomel should be taken either before or in conjunction with aperients. At the same time that great care is taken to provide a healthy action of the bowels, local remedies should be made use of. The ordinary lead-lotion, or one made of one or two grains of sulphate of zinc to an ounce of water, should be applied to the parts morning or night ; or if a more powerful astringent application is required, the patient should use the compound gall ointment, which is an admirable agent. By these means, and by

careful attention to diet, most of the ordinary cases of external piles presented to our notice may be cured, or so relieved that they will hardly excite attention.

If, however, one or more of these tumours become enlarged and inflamed, a much more energetic treatment is required; for there is in such cases very great suffering both local and general. If there is much swelling, and the parts are exquisitely sensitive, the patient must be confined to bed, leeches should be applied to the part, and the bleeding be encouraged by warm fomentations; and subsequently poultices made either of warm bran or of bread, into which half a drachm of laudanum is dropped, should be applied, and changed from time to time. Opium should be given internally; as soon as relief from pain has been procured, the bowels should be thoroughly cleared by a saline purgative. The subsequent employment of a lotion composed of liquor plumbi diacet. dil., liquor ammoniæ acetatis, and spirits of wine—one ounce of each of the latter to six ounces of the former—will cause a shrinking and collapse of the swelling.

Not unfrequently, however, the surgeon is called to a case where most or all of these measures have been tried, and yet the patient is suffering acutely; and on examination it will be found that on one side of the anus there is a tumour of a circumscribed form, of a blue colour, and in a state of great distension. In such an instance, the suffering is produced by the accumulation and coagulation of the blood; and the proper treatment is to puncture the swelling freely with a lancet: there is an escape of coagulated or semi-fluid blood, with almost immediate relief to the painful symptoms. The subsequent application of cold water, or the lotion above mentioned, to the parts freely, will cause an almost entire removal of the disease. If, however, there is much loose and thickened skin over the site of the swelling, it should be removed with sharp scissors, after the part has been punctured.

After repeated attacks of this nature, the anus becomes surrounded with distinct tumours, more or less pendulous, and liable to become swollen and inflamed; for this state of things a removal of the growths by the scissors is required.

Simple as this operation is, it may in unsurgical hands be so mismanaged as to bring about serious results. If too much of the lax skin around the anus be taken away at the same time that the tumours are excised, the parts in healing will cicatrise, so that severe contraction of the anus follows, and the patient is placed in a most miserable plight.

The same effect is likely to be produced if the mucous membrane at the verge of the anus is interfered with to any great extent: therefore, unless there is an absolute necessity for the step, this membrane should not be cut, and only the external hæmorrhoids, with portions of the redundant integument, should be excised.

Internal hæmorrhoids are more frequent, or at all events are more often presented to the notice of the surgeon, because they are productive of much more distress, and more serious consequences are liable to result from them than from the affection situated externally: and here it will be as well to mention the symptoms which are produced by them, and which are local and general.

The first local symptom which attracts the notice of a patient suffering from internal piles is, in many cases, a more or less profuse attack of hæmorrhage, which may not recur for some weeks or months, but which may persist: more or less weight and uneasiness are felt at the seat; and in course of time there will be pain when the bowels are being evacuated and considerable protrusion of the parts will take place. If the patient neglects advice, the tumours come down below the sphincter whenever he takes walking exercise, the constriction caused by the muscle produces congestion in the piles and extreme pain, only relieved by their reduction or by a spontaneous flow of blood, which, however, occurs at most inopportune periods. In addition to these symptoms, there is pain and uneasiness felt in the loins and down the thighs, more especially in females, who very often suffer most acutely, and not unfrequently have their sufferings referred to that prolific storehouse of morbid phenomena, the womb. There is, moreover, a considerable discharge of mucus, or

muco-purulent fluid, from the anus; the bladder is rendered at times very irritable, and retention of urine not unfrequently takes place.

Patients who suffer from internal hæmorrhoids are liable to get them inflamed from some exciting cause, such as an excess at the table, or great irritation of the bowels, and then the symptoms are extremely severe; the tumours protrude beyond the anus, and become constricted by the sphincter. Violent pains are experienced in the pelvic region, and there is a high state of constitutional disturbance, denoted by flushed face, furred tongue, rapid and wiry pulse, and extreme restlessness. If these symptoms are not relieved either by the accidental induction of bleeding, or by surgical assistance, the congestion and inflammation increase, and to such an extent that mortification of the hæmorrhoidal masses ensues, and thus is produced a natural cure; but, on the other hand, it is not desirable to encourage this rude attempt at cure, for death may occur from the violent action set up. Dr. Bushe mentions having seen such a case occur.

When internal hæmorrhoids have existed for a length of time, the general health becomes much influenced; the patient complains of indigestion, flatulence, an inability to follow his ordinary occupation or amusement; moreover, if, as is frequently the case, the disease be attended with periodical bleedings, the face becomes blanched, the pulse weak and rapid, and other well-known symptoms of loss of blood ensue. This is the most serious condition connected with hæmorrhoids of long standing, and hence the reason why it is most important to adopt the proper treatment at an early period of these affections.

Fig. 170.—Internal Hæmorrhoids surrounded by External Hæmorrhoids.

Internal hæmorrhoids present various appearances. On making an examination of a patient who suffers from the milder form of the affection, the veins of the lower extremity of the rectum just within the anus will be found enlarged and distended, forming small fusiform tumours of a deep blue colour covered by a somewhat thickened mucous membrane. In other instances, and especially where the patient complains of bleeding and sense of weight, with scarcely any protrusion, the inferior extremity of the rectum, for an inch or more, will be found highly congested and vascular, the mucous membrane having here and there distinct patches of morbid vascularity, from which, through a speculum, which it is necessary to use in such cases, blood of an arterial colour will be seen to issue. This is the condition which the late Dr. Houston, of Dublin, likened to the diseased lining membrane of the palpebræ in cases of chronic conjunctivitis. In the majority of instances, however, of internal hæmorrhoids, one or more distinct tumours of a rounded or oblong form will be seen to fill up, as it were, the orifice of the anus. In some cases their character and size can be ascertained by an ordinary inspection; but it is always best, in order to arrive at a proper diagnosis, to throw up an injection of warm water, and allow it to be discharged before the examination is made. By this means the tumours are brought fairly down. There are frequently two or three distinct tumours, varying from the size of a cherry to that of a walnut. In one case, the diseased part presents a bright red appearance, easily bleeds when touched, is sessile and not very raised; in another case, the tumour is large, prominent, of a deep blue or reddish-brown colour, having a large broad base, or being attached by a narrower peduncle, and does not

bleed. In these cases the vessels appear to be largely dilated, the mucous membrane covering them being shining and tense, or thick, granular, and slightly ulcerated. Besides these appearances, portions of the mucous membrane, highly vascular and thickened, may be prolapsed at one or more points, as a consequence of the mechanical weight of the internal tumours. In by far the majority of cases of long-standing piles, the integument surrounding the anus is in an unhealthy condition, being much thickened and now and then forming a distinct ring or long pendulous flaps.

There is one point of importance connected with the seat of internal hæmorrhoids which should not be overlooked, but which, as far as I am aware, has not been mentioned by any writer on the subject. The circumstance I refer to is this, that occasionally instances are met with where the hæmorrhoidal tumours are placed, as it were, in separate rows, so that two or three distinct masses exist near the anus; and about half an inch or more above, other tumours of a similar nature are disposed just in the same way. There are one or two specimens indicating this in the Museum of the Royal College of Surgeons. This is a condition of practical importance; for it shows how necessary it is to make a most thorough examination of a person suffering from internal piles. Cases every now and then occur where the ligature has been applied to one or more internal tumours presenting themselves at the anus; and as the operator is thinking his proceedings are satisfactorily terminated, the patient makes some violent straining effort, and another tumour, or series of tumours, which have escaped notice hitherto, are forced into view. These are formed higher up in the bowel, and do not generally protrude; but if a satisfactory cure is expected, they must not be left alone.

As regards the structure of internal hæmorrhoids—when first forming, they are composed in many instances simply of dilated veins, in others of dilated veins and arteries too. As the diseased condition increases, the cellular tissue in connection with the vessels becomes thickened and infiltrated. In a more or less circumscribed space, the mucous membrane also becomes thickened, and is bulged out by the increase in size of the vessels, and thus distinct tumours are formed. The surface of the mucous membrane becomes also exceedingly vascular. On making a section of the lower part of the rectum in some cases of old-standing piles, the veins will be found to be greatly dilated, sometimes partially and irregularly; so that there will be the appearance of distinct cysts; in other instances, the dilated vessels will be found to be filled with coagulated blood and fibrin. In those cases where the hæmorrhoids are of a very bright red colour and sessile, not unlike a strawberry in appearance, and easily bleeding, the structure consists mainly of a series of small arterial ramifications; but where the tumours are of a darker colour, and like a mulberry, they are composed of veins to a large extent, although no doubt the arteries enter as well into their formation; for when the mucous covering is pricked or incised, the blood which flows is of an arterial hue. In those cases of long standing, where the tumour has become very large, and has been submitted to great irritation, a section will reveal scarcely anything beyond a mass of highly-condensed and thickened cellular tissue, with some vessels penetrating the base of the tumour.

The *treatment* of internal hæmorrhoids requires more consideration than that which is adopted for the disease when situated externally. In the cases where the piles have not existed long, are not large, and give only temporary annoyance, much may be done by the patient paying simple attention to his habits, and avoiding those exciting causes which engender the disease. If it is ascertained that a sedentary life has produced the affection, by determining the blood to the rectum, the patient should take as much walking exercise as possible; if the bowels are sluggish, their action should be encouraged by the compound rhubarb-pill, or by a teaspoonful of the confection of senna; and a quarter or half a pint of cold water, or of infusion of quassia, should be thrown up the rectum daily. Dietetic rules must be strictly attended to; for many patients, especially those who are robust and whose circulation is sluggish, will tell us that they feel much more annoyance from piles after they have been dining out, or have taken larger quantities of wine than usual. Hence the necessity for those who suffer from internal hæmorrhoids to abstain as much as

possible from the pleasures of the table. Women in an advanced state of pregnancy suffering from the irritation of piles should be very careful about the condition of their bowels, and should keep the horizontal posture as much as possible.

When internal hæmorrhoids increase to such an extent as to protrude at the closet, and produce considerable pain and bleeding, greater precautions and more decided treatment are needful. The bowels should never be allowed to become costive so as to necessitate straining efforts; the protruded parts should be carefully sponged with cold water, or with a strong infusion of quassia or of decoction of oak-bark and alum in the proportion of half a drachm of the salt to twelve ounces of the decoction, and should be carefully returned by the patient; or, instead of these lotions, the gall-ointment may be smeared over the piles with great benefit. The bleeding, which is often very annoying, may be checked by an injection of sulphate of iron and water, in the proportion of one to two grains of the former to an ounce of the latter; or, if necessary, a lotion of tannin, in the proportion of eight grains to an ounce, may be used; but it must be borne in mind that a moderate amount of bleeding in persons who live high, and whose vascular system is excited, is beneficial rather than otherwise, and should not be interfered with; the popular notion as to bleeding from piles being salutary is by no means incorrect, when applied to certain cases. When, however, the hæmorrhage arises from some peculiar pathological change in the tumour, such as ulceration or excessive vascularity of the mucous membrane, and when it becomes continuous and goes on to such an extent as to interfere with the patient's health, producing a pallid face, a weak pulse, and irritable heart, it should be put a stop to.

A very common internal remedy for piles is the confection of black pepper, in the dose of a drachm twice a day; it may be given by itself, or, as I often use it, mixed with an equal part of confection of senna. It is difficult to say how the remedy acts; it certainly does good not only in this affection, but it is highly serviceable in other affections of the rectum, and especially in those cases where the wounds become sluggish in healing after the operations for fistula, or for fissure of the anus.

When internal piles become inflamed and protruded beyond the sphincter, the patient will suffer much both locally and constitutionally. He must be confined to bed, and the piles, if possible, should be carefully returned by the surgeon; but if this be a work of great difficulty from swelling and congestion, leeches should be applied, and subsequently warm fomentations and poultices. Ice locally applied in a bladder is a valuable agent to diminish inflammation and pain. Opium should also be given in full doses. An operation which may be considered advisable should not be put in force whilst the hæmorrhoids are in a state of active inflammation. Sometimes, as I have before stated, the constriction of the sphincter produces sloughing, and a spontaneous cure takes place; if this is occurring, the process must be expedited by the liberal use of warm bathing and poulticing, and pain must be conquered by the administration of opium.

By the adoption and right application of these remedial measures, a large proportion of cases of internal hæmorrhoids may be cured, or relieved to so great a degree as to prevent annoyance; but many of the cases which come under the notice of the surgeon have existed so long, have reached such a size, and are productive of such troublesome and even serious symptoms, that some active surgical interference is required, in order to bring about a cure or render efficient relief. Originally the usual remedy in aggravated cases was the excision of the diseased part, and it was a remedy accompanied with little pain or difficulty; but the danger of hæmorrhage proved to be so great, that after the sacrifice of several lives the practice was abandoned. It is necessary, even when the excision of external piles is being performed, to take care that the mucous membrane is not too freely clipped, otherwise dangerous bleeding may result. I saw a gentleman nearly lose his life from the inclusion of a portion of mucous membrane in the blades of the scissors during an operation for external hæmorrhoids. The operation was done at 2 P.M.; and at 6 I was sent for, and found that he had been bleeding profusely.

Until within the last few years the radical cure of internal hæmorrhoids was

effected by strangulating the tumour or tumours by means of one or more ligatures so tightly applied that in the course of a period extending from five to ten days the tumours sloughed, and together with the ligatures separated from the bowel. Indeed even now amongst the senior members of the profession this operation is practised, and there cannot be a doubt that, in the absence of a less severe method of treatment, that by the ligature was the best that could be desired, for it was unaccompanied with the dangers which attended upon the operation of removing internal hæmorrhoids with the knife or scissors, and was much more efficacious than the plan of treatment by strong nitric acid.

The operation by the ligature is practised in two ways. In the first method, the patient having been previously prepared by the exhibition of an injection in order to get the parts protruded, the tumours are seized separately by a vulsellum and brought down; the surgeon transfixes the base of each with a stout needle set in a handle and armed with a double thread; this is divided, and the tumour is tightly strangulated on each side, the threads are cut short off and the protruded parts are returned.

A modification of this plan consists in making a free incision by means of scissors at the base or inferior border of the tumour, and then a stout thread is looped around the pile thus bared of most of its surrounding tissue, and is tightly tied. In this operation there is no necessity to use a needle, and of the two operations, should the ligature be employed at all, it is undoubtedly the simplest.

The patient must keep his bed for some days after the operation. A full dose of opium should be given the first night, so that pain may be prevented and the bowels be confined; if there be much pain about the seat of operation, ice applied in a bladder continuously will give great relief. Retention of urine is apt to follow this operation, and when present must be relieved by the catheter. It is desirable to keep the bowels quiet for three or four days, if possible, and then to obtain an evacuation by a dose of castor-oil. Very likely the ligatures will separate on the first action of the bowels; at all events they generally come away on the fifth or sixth day. Some pain is felt in the part for a few days afterwards, and during this time the patient should keep quiet; convalescence may be expected in a fortnight from the time of the operation.

This is the general course of things when the operation is successful and unattended with any evil results of any kind; but it is well known that the use of the ligature is occasionally followed by very serious results: and, indeed, several instances have been made public where death has ensued after this operation, the cause of death being effusion on the brain, tetanus, and pyæmia, the latter disorder most frequently. Several fatal cases have occurred in the practice of my own personal friends, and I have had the misfortune to lose two patients after the use of the ligature. One of these patients was a gentleman in the prime of life and very fair health, who died with well-marked symptoms of pyæmia; and in the other case the fatal event was due to the loss of blood during and after the operation.

But besides the risk of death from some of these causes after this operation, it is known that other serious results occasionally follow and give much trouble.

A circumstance which occasionally obtains after the use of the ligature, and which causes great annoyance, is the existence of long-continuing and painful ulceration at the seat of one or more of the ligatures, for a period varying from weeks to months. Everyone who has had much to do with this operation must have met with such cases. These ulcerations are most difficult to heal, and give great annoyance both to patients and surgeons.

To sum up briefly, then, it may be stated with truth that there are the following objections to the use of the ligature:—The supervention of more or less pain; a tedious convalescence; occasionally death from pyæmia, tetanus, or general constitutional disturbances, and long-continued and painful ulceration at the seat of ligature.

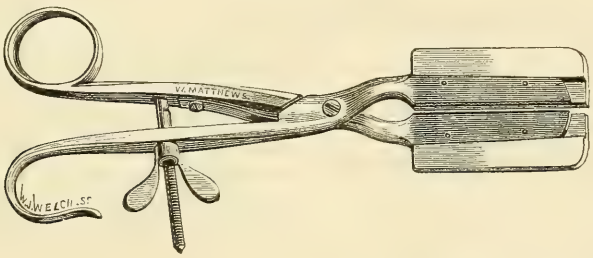
It is the duty of the surgeon to adopt some other means, if he has them in his power, by which these results may be obviated, and by which the disease can be cured; and fortunately he is enabled to effect this by employing a mode of operation which is now being pretty extensively used, and which is well known under the name of the

operation by the clamp and cautery, and which I will now proceed to speak of; but before describing that modification of the operation which was introduced to the profession by myself, I must briefly refer to the history of this mode of treatment, which probably will almost entirely supersede the employment of the ligature.

As far as I am aware, this plan of treating hæmorrhoidal tumours was originally practised by the late Mr. Cusack of Dublin; but its introduction to London surgery is, I believe, due to Mr. Henry Lee, who so long since as 1848 described a pair of forceps or clamp, which he appears to have used extensively; for in his volume of 'Pathological and Surgical Essays,' published in 1854, he has narrated many cases where he employed it, and applied either nitric acid or the actual cautery for the purpose of arresting the hæmorrhage after excising the tumours. In addition to the clamp originally used by Mr. Lee, and which was somewhat cumbersome, there was another kind of instrument, shaped somewhat like a pair of scissors, and which was much more suited for the purpose.

In the year 1863 I first began to treat cases of internal hæmorrhoids and prolapsus by the clamp, employing, after excision, the strongest nitric acid for the purpose of obviating bleeding. I soon became convinced of the value of this mode of treating these disorders, but in a short time I found out that very great improvements in the construction of the clamp were called for, and, with the assistance of the late Mr. Matthews of Portugal Street, I introduced to the notice of the profession the instrument which bears my name and which is now generally used. It is shaped somewhat like the ordinary clamp used by Mr. Curling for the purpose of seizing and applying nitric acid to hæmorrhoidal tumours; but the blades are so constructed that they

Fig. 171.—Clamp.



meet accurately at their edges, and are closely fitted into one another by means of a raised surface on one and a groove on the other edge. In this way, and if the blades are made perfectly parallel, the most accurate compression is made upon a tumour or portion of mucous membrane. A more important feature, however, in the mechanism of this instrument is the adaptation of a light yet powerful screw to the shank of the instrument, just above the handles. The object of this is twofold—in the first place to compress the blades, and in the next to take off the compression after the actual cautery has been applied; and by the slightest turn of the screw, this may be effected so gradually, and yet so thoroughly, that should any vessel be left uncauterised, its situation can be at once seen by the issue or jet of blood, and the cautery can be reapplied.

The latest, and a very important addition to the instrument, consists in the adaptation of a layer of ivory to the outer surfaces and external edges of the clamp, so that the heat from the cautery cannot be transmitted to the surrounding parts, and thus much suffering is prevented.

I will now proceed to describe the mode of application of this instrument, and this description will apply both to cases of hæmorrhoids and prolapsus of the rectum.

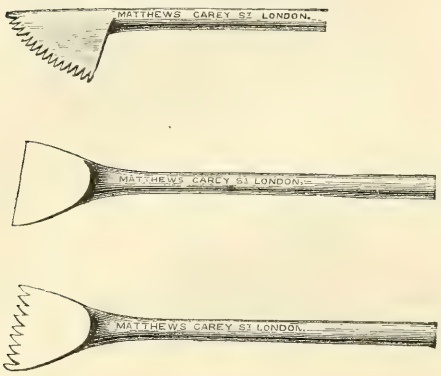
In the first place, the part to be operated upon is made to descend either by means of an enema or by the patient sitting over hot water: the tumour is then seized by a pair of hooked forceps, and firmly held by an assistant. The clamp is now carefully applied to the base of the tumour, and the blades are closed by means of the

screw. After having seen that this is done effectually, the surgeon takes a sharp pair of scissors and cuts off the whole of the tumour; the cut surface is wiped, and carefully and repeatedly touched by the heated iron until it is considered that the entire surface is thoroughly cauterised.

The screw is now gently turned, the grasp of the clamp is thereby somewhat relaxed, and if any vessel has not been sealed up it will emit blood, and the cautery can be again applied. Sometimes this process may be needful two or three times before the bleeding is quite stopped. As soon as it is ascertained that the surface has been thoroughly cauterised, the clamp is removed, and if more than one tumour exists, each of them is successively dealt with in a similar manner. The finger, oiled, is then introduced as far up as possible into the bowel, so as to push the parts well up and cause the sphincter to contract; a suppositorium of two grains of extract of opium is introduced, and the operation is completed. If only one tumour requires removal, the proceeding may be finished in a minute or two; but if there are several tumours, the operation cannot be safely or satisfactorily concluded under ten or fifteen minutes.

Since the issue of the last edition I have made an important modification of this operation, consisting in the removal of the tumours by the heated cautery instead of the employment of scissors. The cautery is so constructed that its blade may be set either at a right angle to the shaft or parallel with it, and may form a triangle or half-moon, and its edge is serrated. When the tumour is embraced by the clamp it is seized by a blunt vulsellum and drawn forward; the cauterising iron is then applied at a dull red heat, and made to travel along the upper surface of the clamp steadily and slowly. By this means the tumour is removed, and of course every vessel is cauterised in this process. And thus the surgeon possesses a more thorough means of preventing hæmorrhage. I have now almost entirely discarded the use of scissors.

Fig. 172.—Cauteries.



For the purpose of locking up the bowels, the same precautions as are needful in other operations on the rectum are taken. At the end of the third or fourth day a dose of castor oil is given and the bowels are generally easily moved; a little blood which has collected in the bowel either during or after the operation may come away. If the patient has not been much weakened by long-continued hæmorrhages, he or she may be allowed to get up; and in by far the majority of cases they do so; but if the health has been much shaken, or the operation has been extensive and has involved the removal of much skin, it will be advisable to keep the patient in bed or on the sofa until the bowels have been acted upon a second time, two days afterwards, when it will be found that the patient is able to move about or attend to his ordinary business.

I have now performed this operation in many hundreds of cases, and I can with truth state that, if it be properly done, there is hardly an element of danger in it. I have operated at all ages, from puberty up to eighty, and in instances of the utmost severity, in cases where the tumours have been immense, and when the patients have been so thoroughly blanched by long-continued bleeding that one would not dare to perform any operation unless convinced of its safety.

This operation is, I believe, particularly adapted for those cases of severe hæmorrhoids or prolapsus where, either from age or from the presence of some other concomitant disease, the operation by the ligature would of necessity be attended with danger. Thus in two instances of severe hæmorrhoids, attended by symptoms of paralysis, where the local disease produced much annoyance, I did not hesitate to use

the clamp, although in each case the patients were advanced in life; and the operations were attended with as little disturbance as in perfectly healthy individuals.

The advantages which I claim for this proceeding, which I now always adopt in cases of hæmorrhoids or prolapsus, are, that there is considerably less risk to life than when the ligature is used; that in the majority of cases the suffering both attending and following the operation is much less, and that the period of convalescence is rendered much shorter. It is true that the operation itself is complicated and somewhat tedious, as compared with that by the ligature, but these considerations ought not to weigh with the surgeon when the advantages of any particular proceeding are great and palpable.

A method by crushing has been introduced by Mr. Pollock and Mr. Benham. The operation consists in using a clamp which is applied to the base of the pile after being drawn down, and the blades are firmly closed by a screw. The pile is then removed by a pair of scissors, and the clamp is retained for two minutes. If any vessel bleeds on the release of the clamp a ligature must be applied. Mr. Coates of Salisbury has recently used a method consisting of their removal by cutting so as to get speedy union of the wound. A clamp is applied to the pile, catgut ligatures are passed through the base of the pile behind the clamp; the tumour is removed by cutting, and, the clamp being released, the sutures are drawn together; any vessel which bleeds being previously tied.

Nitric acid was strongly recommended by the late Dr. Houston of Dublin as a means of getting rid of some forms of internal hæmorrhoids. I have been in the habit of using it in certain cases of hæmorrhoidal affections for many years. Mr. Henry Lee has incorporated with his Surgical and Pathological Essays an admirable paper on this subject, and has spoken highly of the plan of treatment which I am now about to consider.

I have stated, whilst describing the nature of internal hæmorrhoidal diseases, that the condition in which they are found varies. I have endeavoured to point out those cases to which an operation is applicable, and have stated that this practice is justifiable in those instances where the tumours are large, mainly composed of tissue, in which the veins predominate, and have become indurated.

There are, however, other instances where the hæmorrhoidal tumours are small or moderate in size, and where they are evidently composed of morbid texture in which the small arteries rather than the veins are interested, as shown by their bright florid aspect, and by their tendency to pour out arterial blood whenever the patient is at the closet, or when the tumours are handled. These tumours are sessile, and generally not very prominent. They produce exceeding annoyance, and indeed prove most destructive to the health, as they generally yield a great deal of blood. Now, in such cases, an operation will undoubtedly be as effective as in the other instances before described; but this proceeding is not necessary, as the local use of the nitric acid is so eminently suited to them. The relief which one single application of the acid gives in these cases is remarkable; and an excellent cure may be effected if the whole of the diseased texture be subjected to its action.

About this particular kind of case there is no doubt in the mind of any surgeon who has seen the nitric acid applied in a proper manner. There is, however, a mixed class of cases where the remedy is an uncertain one, but in which nevertheless the surgeon is justified in trying it, and where I sometimes have succeeded when I little expected it. I refer to those cases where there is a hæmorrhoidal mass, consisting perhaps of one tumour mainly composed of venous ramifications and of a bluish colour, with one or more presenting the characters of the florid sessile pile; or one portion of the tumour or tumours may present the dark blue appearance and thickened membrane, and another portion of it may be brightly vascular, and have its mucous covering granular or slightly ulcerated. In this kind of mixed case I do not hesitate to try the acid, if the patient is particularly desirous; but I make a point of stating that it is impossible to depend upon any curative action in such a case, although in some instances the remedy has acted most efficiently.

To apply the agent in those cases where the tumours are large and indurated,

and have a deep blue colour, would be perfectly useless, and only bring discredit upon the nitric acid as a means of cure in other kinds of hæmorrhoidal diseases.

It is, however, in that class of cases not unfrequently met with, where there is not so much any decided hæmorrhoidal tumour, but where there is a congested and relaxed condition of the mucous membrane of the rectum, attended with bleeding to a greater or less extent, that the nitric acid acts so beneficially. Dr. Houston has compared this condition of the rectum not inaptly to that of the thickened conjunctiva after long-continued ophthalmia. The application of the acid to the diseased points from which the bleeding proceeds will soon remedy all the bad symptoms.

The following is the mode of applying nitric acid:—The bowels having been well evacuated some hours previously, the diseased portion to which the application is going to be made should be well exposed by making the patient sit over hot water for some few minutes; or if this is not sufficient, an enema of water should be thrown up the rectum, and the hæmorrhoidal disease will be brought well into view. The part to which the acid is to be applied should then be carefully wiped with a piece of lint. The surgeon then dips the extremity of a small flat piece of wood into the nitric acid, and touches the diseased surface carefully with it. The part touched, and the neighbouring mucous membrane, is well smeared with oil, and the whole is returned within the orifice.

It is not necessary to confine patients to their bed after the acid has been applied; and this is one of the reasons why the remedy is so desirable, many patients having neither the time nor inclination to submit to an operation which may keep them from their business or pleasures for a fortnight or more.

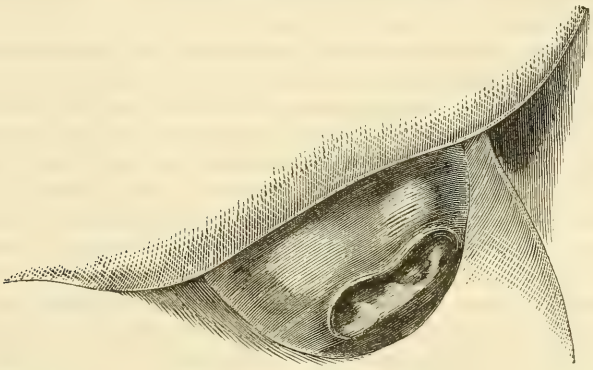
Within the last few years some French surgeons, and especially M. Chassaignac, have strongly recommended the employment of the écraseur for the removal of internal hæmorrhoids. The practice has also, to some extent, been followed by surgeons in this country. The object sought by the use of this instrument is the more or less rapid removal of the tumours without hæmorrhage. That this can be effected in a great number of instances there is not a doubt; and if no evil result were likely to follow, this practice would in all probability be adopted in many of those cases where an operation was required, notwithstanding that there is a great deal of pain attendant upon the process. One very serious consequence, however, of this plan of treatment has been met with in several instances in Paris: this is the occurrence of stricture of the rectum some time after the wound has become cicatrised. This very grave objection to the employment of the écraseur is sufficient to counterbalance its real or supposed advantages; and although it would not be wise entirely to discard its use, the necessity for it must be rare, and in those few instances where it would be required, the surgeon would do well to take every precaution to avoid the occurrence of contraction of the gut.

Prolapsus of the Rectum.

During the time that the rectum is evacuating its contents in a natural and normal manner, more or less extrusion of the bowel occurs; but this is only momentary, for as soon as the action is finished, the mucous membrane is immediately withdrawn within the anal orifice, and no inconvenience results. When, however, from some particular cause, there is any impediment to its return, those changes, which ultimately lead to the disease we are considering, occur; the mucous membrane becomes congested and swollen; its attachment to the muscular tissue, naturally loose, becomes weakened; and in course of time the protrusion of the membrane becomes habitual, constituting one form of prolapsus of the rectum, and that the most frequent. In other cases, however, there is a protrusion not only of the mucous and submucous tissues, but of the whole of the thickness of the lower part of the bowel as well. A preparation in the Museum of King's College puts an end to all doubt on this point. This kind of prolapsus occurs not unfrequently in children, and is of great extent, the protruded bowel being sometimes five or six inches in length. In very old people, this complete prolapsus of the rectum occurs,

reaching to an immense size. On examining a recent case of prolapsus of the rectum, where the least amount of change has taken place in the structure of the parts, as for instance in a child, the protruded part is found to form a tumour of an oblong shape and cylindrical form, presenting externally the smooth vascular surface of the mucous membrane, which is generally of a more or less bright red colour, and covered with mucus; at the extremity of the tumour is the orifice or cavity of the bowel, and at the anus there is no deep furrow between it and the protruded part, as there is in the intussusception of the rectum. Even in the adult, when the prolapse is large and of recent occurrence, this mucous membrane may be as un-

Fig. 173.—Prolapsus in Child.



changed in appearance and texture as when it occurs in the child, but the tumour has more of a globular form.

The most frequent condition in which a prolapsus of the rectum is seen is where there are one or two lateral folds of the membrane, varying from one to two inches in length, protruded from the anus, or one unbroken ring of protruded membrane is seen—but this is more rare. If the disease has not long existed, the membrane is not much changed in appearance, being only somewhat thickened and more vascular than natural; but should the bowel have been habitually prolapsed for some years,

Fig. 174.—Prolapsus in Adult.

considerable changes take place, and on examining an old case, the following will be the appearances. Externally, there will be a ring of thickened integument; within this the flaps of mucous membrane hang down, their lower portions being much thickened, having lost the peculiar character of mucous membrane, and being assimilated to integument; this change has taken place because the most dependent portion is that which either habitually remains protruded altogether, or is protruded for a longer time, and more exposed. On separating the flaps of the prolapsus, the upper part of the membrane is found either but little altered from its natural character, being red, smooth, and vascular, or superficial ulceration may have taken

place where the two portions have been in contact. There is more or less mucous discharge produced, but in pure prolapsus there is little hæmorrhage.

Sometimes, in persons advanced in life, the protruded part consists of a tumour as big as the fist, which has habitually protruded for a long time. In such a case, a very large proportion of the tumour consists of membrane more like leather than the natural tissue. In these old-standing cases, the sphincter becomes extremely relaxed, and the anus very capacious; there is generally a redundancy of loose and thickened skin around; sometimes it hangs down in long pendulous flaps—this state of the parts adds materially to the facility of the occurrence of the prolapsus.

In many cases the prolapsus of the rectum is complicated with distinct hæmorrhoidal tumours, which in fact are mainly, if not entirely, the originators of the affection; for when one or more internal tumours exist, they themselves, each time the bowels act, become protruded, and drag portions of the mucous membrane down with them; so that not unfrequently a patient presents himself with one or more folds of prolapsed membrane, and at the same time with distinct hæmorrhoidal tumours.

The inconvenience and suffering which prolapsus causes is considerable, for although at the onset of the affection the protruded part may pretty readily return within the sphincter after an evacuation, as time wears on it becomes necessary for the patient himself to return the part, which not rarely is a task of difficulty, and attended with pain; moreover, from the contiguity of the rectum to the neck of the bladder and urethra, there is often great distress of these parts—constant irritability, and even retention of urine, being an accompaniment of the affection; pain and uneasiness is felt in the loins and down the thighs; the intestinal canal and stomach also sympathise, the patient being troubled with flatulence, loss of appetite, and low spirits.

If the prolapsus cannot be returned by the patient, most violent symptoms occur —extreme pain in the part, and retention of urine; and if unsuccessful attempts are made to reduce the swelling, which is in all probability tightly constricted by the sphincter, violent inflammation of the part, attended with severe constitutional suffering, occurs; and in some instances sloughing of the protruded bowel takes place, by which means a cure is brought about, but the mischief may be such as to cause death. In cases where a prolapsus occurs in children to a great extent, and has been allowed to remain down for two or three days, the local and constitutional changes are not so severe; the prolapsed membrane, however, becomes exceedingly congested.

The causes of prolapsus are constitutional and local; thus, the disease is very frequently met with in individuals who have suffered from general debility and laxity of fibre. In children especially the affection is met with in instances where the health has been much reduced by insufficient nutriment, bad air, and want of proper attention. An adult or old person who suffers much from prolapsus usually has a weak pulse, a flabby tongue, and impaired digestion; and in the child there is an unhealthy and dry skin, a foul tongue, and a tumid belly. The local causes which produce falling of the bowel in children are stone in the bladder, and ascarides. In adults, constipation, sedentary occupation, the straining caused by stricture of the urethra, and enlargement of the prostate, are fertile causes of the disease. There is no doubt, moreover, that the pernicious plan of frequently using copious enemata is very constantly productive of the disorder.

In considering the treatment of prolapsus of the rectum, we shall first refer to that which is necessary in removing the affection as it is met with in young children. In the first place, it is necessary to seek for its cause; and especial inquiry should be made with reference to the urinary apparatus, for it not unfrequently happens that it is the irritation of a calculus in the bladder which produces the extrusion of the gut; and if this be so, it is obvious that the remedy consists in the removal of the stone. If there be not stone in the bladder, a collection of ascarides in the rectum may originate the disease; and the destruction of these parasites by a few doses of scammony and calomel, together with the daily injection of a few ounces of strong infusion of quassia, will prevent the prolapsus.

In by far the larger proportion of cases occurring in children the general health

will be found at fault, and this must be attended to before the prolapsus can be got rid of. In the first place, it is necessary to return the protruded bowel; and this is sometimes a work of difficulty, because the child struggles violently and cries. The protruded bowel should be gently but firmly grasped by the right hand, well oiled; careful pressure, so as to empty the vessels, should be employed, until the whole is returned within the sphincter. When the protrusion has been large, however, and the child is very violent, the gut will soon fall again; and in this case the best plan to pursue is to place the child under the influence of chloroform, and the bowel will be readily returned. A pad and bandage should then be employed in order to secure the part, and the buttocks and thighs should be closely retained together by the application of strips of plaister. The secretions of the liver and bowels should be rendered healthy by the use of small doses of rhubarb and hydrarg. c. creta; the skin be kept in good order by the warm bath; the child should be carried about in the fresh air; the diet must be nutritious and in small volume; and the strength and appetite are to be increased by small doses of the pulvis cinchonæ and soda. As the health improves, the prolapsus will cease to appear; but should this persist, the part may be bathed with a solution of sulphate of iron, gr. j. to ℥j. of water; or an injection of tincture of sesquichloride of iron, ℥j. to ℥vj. of water, may be thrown up every morning after the evacuation of the bowels, and after the protrusion has been returned. In some cases the prolapsus will recur whenever the child evacuates. This accident, however, may be prevented by so managing that the child should be in a kneeling posture during the act. Another plan which sometimes succeeds in preventing the protrusion consists in an attendant drawing on one side the skin of the anus with some force during the time the bowel is being emptied; by this means a certain amount of temporary contraction is produced which prevents the descent of the gut. In adults, a considerable number of the cases which are not severe, and which have not been of long standing, may be cured by careful attention to the removal of those causes which have produced the disorder. Thus, if it has resulted from violent straining and constipation of the bowels, some mild aperient should be exhibited occasionally, which will prevent accumulation in the bowel, and render the contents more fluid. The compound rhubarb pill at night will have this effect; or, what is perhaps better, one or two teaspoonfuls of confection of senna should be taken. The patient should not eat largely, and should especially avoid vegetables in any quantity. He should take exercise, and be careful to use plenty of cold water to the parts after the action of the bowels. Occasionally a little cold water, or a few ounces of the decoction of oak bark, may be thrown up the rectum; and if there be the least protrusion left after the evacuation of the bowels, the gut, having first been well sponged, should be carefully returned.

By attention to these various measures, a prolapsus of small extent may either be entirely cured, or be prevented from increasing or proving troublesome. And therefore it is of the highest importance to place reliance upon medical treatment in such cases. In by far the majority of cases, however, which are presented to the notice of the surgeon, the prolapsus is either very large, or has existed so long a time that medical treatment would be of no use whatever. And then some strictly surgical means must be adopted, if a cure, or even if palliation of the disease, is looked for. If the case is of only recent occurrence, and yet the prolapsus be very voluminous and incapable of being returned, thereby causing much alarm and suffering, it is the duty of the surgeon at once to reduce the prolapsed bowel. This is best effected by placing the patient on his side, with his knees drawn up, and grasping the tumour either with the naked hand well oiled, or with a cloth intervening. Firm and steady compression should be used, until the whole of the tumour be returned within the sphincter. The patient should then lie quiet for some hours, and afterwards a pad should be applied to the anus, and be secured by a firm bandage across the perinæum and around the loins. In order to prevent a return of the prolapsus, the whole or greater portion of the mucous membrane should be smeared over with solid nitrate of silver, or even with strong nitric acid, previous to its being returned by the surgeon. In one remarkable case of immense size occurring in a young man, I adopted this plan, with

the result of obviating the necessity of a bandage, which he continually had worn before.

In order to bring about an effectual cure of the chronic and severe cases of prolapsus, more decided means must be adopted. We have seen that the disease essentially consists in a relaxed and thickened condition of the mucous membrane, and a separation, as it were, of this from the muscular coat. When this is involved also, there ensues a weakness and detachment of the whole of the thickness of the bowel from the surrounding supports. The object to be obtained is to reduce the redundancy or relaxation of the mucous membrane, to promote adhesion between the several tissues composing the bowel, and to brace up the anus and the sphincter. The late Mr. Hey of Leeds was the first to propose a proceeding which ensured the latter result; and this consisted in removing the loose and pendulous flaps of skin which existed around the margin of the anus, in the case alluded to by him in his 'Practical Observations on Surgery,' p. 443. In some cases, where the sphincter is very relaxed, and the flaps of integument loose and thick, a cure may be brought about by the removal of these alone; but when the prolapsus is very large, and a considerable portion of the mucous membrane has become converted into tissue approaching to integument, it will be necessary to adopt the modification of the operation proposed by Dupuytren, which consists in removing radiating folds not only of the skin at the margin of the anus, but also portions of the diseased mucous membrane. This operation is effected by laying hold of the fold of skin on each side of the anus with forceps, then with a sharp curved pair of scissors removing both skin and mucous membrane. In very severe cases four or six applications of the scissors may be necessary. The operation is soon accomplished; as the wounds heal, contraction takes place, the aperture of the anus becomes diminished and braced up, and the prolapsus no longer occurs.

It is important to bear in mind that, in very severe cases, not only is it necessary to remove the relaxed integument, but portions of the mucous membrane, which in instances of long standing has become converted into a tissue more like leather than anything else, must also be taken away. If this step be not resorted to, a disappointment will ensue as regards a complete remedy of the prolapsus. Hence the surgeon must think of the possibility of somewhat severe hæmorrhage, which will occasionally occur. After a portion of the mucous membrane, however small, has been snipped away, I have seen it occur to a very great extent, and when it was least expected.

If hæmorrhage to a large extent does occur after a surgical operation on the rectum, the patient will in a few hours complain of tenesmus, and express a desire to go to the closet; he will then evacuate a large quantity of blood and become faint. In such a case it will be necessary to clear away any coagula which may be in the gut, to elevate the pelvis, and introduce some ice into the bowel. Should this not stop the bleeding, a careful examination should be made with a speculum, and the bleeding orifice be looked for and tied, or, if at hand, the hot iron should be freely applied. Sometimes it will be difficult, or almost impossible, to effect this; and then the rectum must be carefully plugged by portions of sponge or lint, to which a thread should be tied, that the compress may be more readily withdrawn when the bleeding has ceased.

It may here be stated, that the risk of severe hæmorrhage after the mucous membrane has been excised may be in a great measure obviated by the surgeon taking care to introduce, through the edges of each incision, one or more fine sutures before the patient is left.

Another mode of curing prolapsus consists in the application of the ligature to portions of the prolapsed membrane. This plan is especially adapted to those cases where there is great laxity of the mucous membrane, and where the surrounding integument is not much involved; also to those cases where the prolapsus is associated with one or more hæmorrhoidal tumours. This operation was originally proposed for prolapsus by the late Mr. Copeland, who found it to answer his expectations most admirably. It is easily done, by pinching up, with a pair of forceps, small

portions of the diseased membrane, applying around each a tight thread, cutting off the extremities, and returning the parts within the sphincter. If there are distinct hæmorrhoidal tumours to deal with, the operation as undertaken for them, and described in another place, must be performed. As the prolapsus is in a great measure the result of the hæmorrhoids, the cure of the latter will be followed by the disappearance of the former. In some cases of prolapsus where the mucous membrane is not altered in its texture, strong nitric acid is used with great benefit.

Cases of prolapsus are occasionally met with in persons of very advanced age, or who are suffering from some internal disorder which would forbid the employment of the ligature. Probably there is, in conjunction with an extensive prolapse of the mucous membrane, a very weakened condition of the sphincter, and an abundance of loose and thickened integument around the anal orifice ; consequently the use of nitric acid alone will not suffice to remedy the disorder, even if the mucous membrane be not much altered in its character. In such cases I combine the use of the nitric acid with the removal of two, three, or four slips of the thickened integument from around the margin of the anus. The acid should first be thoroughly applied to the mucous membrane on one or more occasions ; and after the lapse of a few days the subsequent part of the treatment should be adopted by using the scissors in the manner before described. Most beneficial results will follow from this practice, and it may be undertaken without fear of danger in cases where the ligature would not be justifiable.

Although either of these methods of treatment may be adopted with success, I now almost invariably remove a prolapsus in the adult by the operation with the clamp and cautery, as in instances of hæmorrhoids, and in precisely the same manner. If the tumour be small, it is only necessary to remove one or two folds of mucous membrane ; but if, as in some cases, it be very voluminous, it is needful to apply the clamp to several portions of the protruded membrane. If there be great laxity of the anus with redundancy of skin, two or three slips of the latter should be removed with the scissors, as in the operation of Dupuytren. I find this treatment is just as successful as when it is practised for the removal of hæmorrhoids.

In those cases where any operative measure is not advisable, great relief may be obtained by the use of a pessary or spring pad.

Fistula in Ano.

The artificial communication between the cavity of the rectum and the neighbouring textures denominated fistula in ano constitutes an affection of very great interest and importance, as there is a difference of opinion regarding the exact pathology ; and for the most part an operation more or less severe is required for the cure of the disease.

Very opposite opinions have been propagated by eminent surgeons regarding the formation of fistula. Thus, it has been confidently asserted by Sir B. Brodie that the origin of the disease was the existence of an ulcer in the mucous membrane, and that the suppuration in the neighbouring textures was subsequent to and dependent upon this ulceration. On the other hand, it has been as confidently stated by Mr. Syme that the first step in the formation of this disease was an inflammation and suppuration in the cellular tissue external to the bowel, and that the abscess subsequently opened into the gut, and thus the fistula was constituted.

There can be no doubt that the disease originates in both ways. We are acquainted with the fact that inflammation and ulceration of the mucous coat of the rectum occur both spontaneously and as the result of injury produced by foreign bodies ; ulceration having occurred, some of the contents of the rectum escape into the surrounding cellular tissue, and excite suppuration.

A fistula is sometimes produced by direct violence ; an illustration of this occurred recently in my practice. A gentleman had a bougie roughly thrust up his anus ; this penetrated the coats of the bowel, suppuration took place in the tissues around. I saw him seven weeks after the accident, and found an opening in the bowel the size

of a sixpence leading to the cavity; there was no external opening. In the operation I made an incision in the skin and laid open the parts included, and the fistula was soon cured.

In the majority of cases of fistula in ano, the first step in the formation of the disease is the existence of an abscess in the cellular tissue surrounding the bowel; as the matter increases, the various textures are involved, the cavity of the bowel is pressed upon, the mucous and muscular coats are separated to a greater or less extent, and at last the former membrane is penetrated.

The external opening may present itself as a simple minute puncture, and when situated close to the anus may be so hidden between the folds of the integument as readily to escape observation, unless it be carefully looked for; the only thing which marks its presence being a slight moisture escaping from one point when pressure is made. In other instances of more extensive and old-standing disease, the opening or openings present themselves as somewhat prominent apertures, not unlike those seen in connection with dead bone, and surrounded by more or less erythema of the skin, so that there is not the least difficulty in finding them.

Although for the most part it will be found that the external opening of a fistula is by the side of and some little distance from the anus, it is well to know the fact that sometimes it is so close to the circumference of the anus that it is necessary for the patient to protrude the parts well before this aperture can be discerned.

An external opening does not always exist, and then is constituted what the older surgeons named a blind or incomplete fistula. This form of the disease is somewhat rare, and it is very likely to be overlooked or misunderstood.

The internal opening of a fistula nearly always exists; and indeed, according to that view which looks upon the formation of the disease by preliminary ulceration of the mucous membrane, an opening must necessarily obtain; but there is no doubt that there are cases of incomplete fistula where there is no opening into the bowel; an examination on the living body alone might not be a sufficient proof of this, for the opening may exist, and not be ascertained; but no such source of deception can occur after death. There are three specimens in St. George's Hospital Museum, as well as two preparations in the Museum of St. Bartholomew's Hospital, which show this. On careful examination, however, it will be noticed that the mucous membrane of the rectum at the spot where the opening would have existed is very much thinned.

Formerly it was considered that the internal opening was situated much higher up than is really the case. Subsequent investigations, however, and especially those instituted by Sabatier, Ribes, and Velpeau, have proved that in the larger number of instances the internal opening is situated within an inch or an inch and a half from the anus. In more rare cases, however, it happens that the internal opening will exist as high up as three inches from the anus. It is rare that more than one inner opening exists; and it has been affirmed by a recent writer that it is always single; but this is an error, as cases are occasionally met with where there are two or more distinct apertures in the gut. And it is easy to understand how this occurs; for in some of the more severe cases of abscess near the rectum the matter strips up the gut, separating it from the cellular tissue to the extent of three or four inches; and it is but likely that the mucous membrane should become thinned, and ultimately perforated, by the pressure of the matter at more points than one.

The course which the sinus takes differs; it may be simply subcutaneous. Very frequently it runs through the fibres of the external sphincter, or it may be found to traverse the substance of the levator ani. In one very beautiful preparation in St. George's Hospital Museum the fistulous canal is shown to be running closely beneath the fibres of the internal sphincter.

Sometimes the result of extensive suppuration around the lower part of the rectum is the formation of a double fistula, either complete or incomplete; that is to say, there may be a fistulous tract on either side, having an internal as well as an external aperture; or a sinus may exist on either side of the bowel, and yet there be only an opening into the latter on one aspect; or there are two sinuses, one of them

opening both into the bowel and on the skin, whilst the other has only an internal aperture. There is occasionally also a curious condition, where the fistulous sinuses surround the back part of the rectum, and have a common opening in the bowel; this form of the disease has been not inaptly called the *horse-shoe* fistula. In very severe cases the sinuses are found to be branching out across the buttock in various directions; this state is not uncommonly associated with stricture of the bowel of either a simple or malignant character. In an instance which I saw in consultation with Mr. Holberton of Hampton, the sinus extended so far down as the lower third of the thigh posteriorly. The fistula in this case was the result of stricture one inch from the anus.

The causes which produce fistula are various, and, understanding its pathology, we must look to those circumstances which are liable to excite inflammation and suppuration about the rectum. In some rare cases the disease is of a traumatic origin. Thus a fish-bone may have adhered to the mucous membrane of the rectum, and produced ulceration and subsequent abscess, which has degenerated into fistula; or the ulceration may have primarily taken place in the mucous membrane in persons who have suffered from severe dysentery. In the greater number of cases, however, when abscess has been the primary step, the morbid action has been idiopathic, occurring in persons who have been out of health, or who have been ill from some specific disease. Those who have lived long in tropical climates, and who have suffered from disease of the liver, are doubtless more liable than others to get fistula. A violent blow upon the perinæum or ischio-rectal region will produce abscess which will terminate in fistula. I have recently operated upon a very healthy young man where the disease could be traced to this source.

When an inner opening exists without any external aperture, the diagnosis is somewhat difficult. The patient will complain of having suffered from more or less pain about the rectum; this had gradually become more severe, until there was perhaps some alleviation, accompanied with a discharge of purulent matter from the anus. On examination, the surgeon will detect a distinct and circumscribed induration by the side of the anus, very painful to the touch; and on pressing the part towards the anus purulent fluid will be observed to escape in considerable quantity. And when the integument has become thinned, fluctuation may be discovered; but not in all cases.

It should not be taken for granted that, because a sinus exists close to the anus, it must be connected with the rectum; for abscess and fistulous openings may exist in connection with disease in other parts. Thus sometimes an ordinary pelvic abscess may discharge itself close to the anal aperture, or an abscess in communication with the hip-joint will open into the ischio-rectal fossa. An abundant discharge from a cavity connected with the prostate gland took place in this situation in a recent case under my own care. Necrosis of the tuberosity of the ischium or of the extremity of the sacrum may exist, and the aperture in connexion with the disease may be present in the same situation.

I attended an elderly gentleman some time since who had suffered for several years from a fistula. Two operations had been performed upon him by a most eminent surgeon, but the fistula remained unhealed. When he came under my observation a most careful examination was made with the view of detecting the cause of the failure of these operations; and by passing the probe up to the posterior part of the rectum, a portion of necrosed bone was felt. The fistula was freely incised, and a small piece of the sacrum was removed. The existence of this disease had been overlooked, and hence the failure of the two previous operations, which had been performed as for an ordinary fistula in ano. I may mention that after the third operation the patient perfectly recovered.

In order to bring about the cure of a fistula in ano, it is necessary in the great majority of cases to perform a surgical operation, which fortunately, from the attention devoted to this disease by Pott and others, is a much more simple business now than it was in former days, and if proper judgment be used in selecting the cases, is almost always attended with success.

Before, however, proceeding to consider more especially the treatment for the disease when the fistulous communication has been formed, it is necessary to make

some observations on the importance of dealing promptly with the inflammatory and suppurative process which forms the first stage of the affection. When a patient is suffering from the symptoms of threatened abscess near the rectum, he should lie in the recumbent posture, and the bowels should be thoroughly evacuated by a dose of calomel, followed by castor oil; hot fomentations and poultices should be assiduously employed, and the diet must be sparing. By the early adoption of these measures threatened abscess will be arrested, and all the symptoms subside. If, however, there be good reason to believe that matter has already been formed, it will be necessary, in order to prevent a fistula, to make a free incision into the centre of this swelling with a narrow sharp bistoury. In some cases, where the pus is deeply seated, the point of the knife must be passed much farther than would at first appear to be necessary. In such a case the evacuation of the abscess will be facilitated by the introduction of the left forefinger into the gut; by its assistance the swelling may be pushed forwards and made more prominent. When the abscess has been opened, it will be prudent to insert a small portion of lint into the aperture, in order to prevent its closure. The part should then be well poulticed, and the patient should remain quiet during a few days.

In many cases, where the inflammation of the cellular tissue has not existed long, and where the general health is not much at fault, an abscess close to the rectum will completely heal by this prompt evacuation of its contents, and thus the fistula will be prevented. Hence is shown the vast importance of properly understanding the pathology of this disease, and thereby being able to arrest it in its first stage.

In those cases, however, where there has been extensive mischief, and the lower part of the rectum has been much denuded, or where the general health has been weakened from this or some other cause, even this prompt surgical treatment will not prevent the abscess from degenerating into a fistula; and in other very numerous cases, the abscess has been allowed to burst, and the fistulous communication between the gut and the external surface has been formed.

In some cases where the sinus is short and free from induration, it may be made to heal by the employment of irritating injections thrown into the canal. Those which are likely to prove of most service are injections composed of the pure tincture of cantharides, or of the tincture of iodine undiluted, which should be used daily. Another method of healing these fistulæ consists in irritating the sinus by passing a silver probe covered at its extremity with fused nitrate of silver. Each of these measures is occasionally successful, especially when, at the same time, the general system is improved by medical treatment, and by change of air. Therefore, in those cases where there is no cause for hurry, or where the patient is unwilling to undergo an operation, these means of cure should be tried perseveringly, and both patient and surgeon will sometimes be rewarded with success.

Fistula in ano may be treated successfully by ligature, and it is a method which was warmly recommended by Mr. Luke. The operation is effected by passing a common ligature, by means of an eyed probe, through the external aperture into the bowel; then adapting the two ends of the thread to a small screw, which can be tightened from time to time as the ligature is cutting its way out from the fistula. The process of separation is generally completed in a week or ten days; and as the ligature ulcerates away, the cavity behind becomes gradually filled up. The mode adopted and the instruments used by Mr. Luke are described in the 'Lancet' for 1845, p. 221.

There are some advantages in the ligature. Thus, it may be employed without fear of producing hæmorrhage; and therefore in those rare instances where the inner opening of the fistula is situated high up, and where serious bleeding may be expected to arise after a cutting operation, this mode of treatment should be adopted. Again, there are patients every now and then to be met with who are so nervous about a cutting operation, that even with the promise of chloroform, they will not submit to the knife; in such the treatment by ligature can be advantageously substituted. It is not a method adapted to cases where the sinuses are very tortuous and extend in various directions; but in those instances where the fistula is simple, there is no doubt

that the application of the ligature will be followed by success, although the process is a somewhat tedious one, and sometimes it has to be abandoned in consequence of the pain and annoyance caused. The use of the elastic ligature has lately been advocated in the simpler forms of fistula by Mr. Allingham.

In by far the majority of cases of fistula in ano, an operation by the knife—that commonly denominated *the operation for fistula*—is needed, if a satisfactory and efficient cure be looked for. This consists in the division of the structures situated between the sinus and the cavity of the intestine, and, in fact, the laying open of the entire fistula from one orifice to the other. This proceeding is rendered necessary in many cases of obstinate sinuses situated in other parts of the body; and it is easy to understand how imperatively it is called for when a sinus implicates a part periodically acted upon by a powerful sphincter muscle, whose contractions alone will suffice to prevent the healing of the fistula, even were there no other causes at work to impede this process. The object, therefore, of the surgeon in performing the operation is not only to lay the sinus open, and thus place it in a more favourable condition to heal, but by dividing the sphincter muscle to paralyse its action for a time, and thus to keep the wound at rest—a proceeding found to be essential for a cure, not only here, but in the treatment of wounds, sores, or injuries in other parts of the body.

The operation, as performed now, is, in the majority of cases, a simple one, compared with the same before, or even after, the days of Pott, whose writings tended so powerfully to diffuse correct views regarding the pathology and treatment of fistula in ano. Instead of excising the fistulous tract, or even of making very free incisions high up in the gut, the surgeon only finds it needful to divide those structures which are limited by the two orifices of the sinus; and it is now pretty clearly ascertained that, in the majority of instances of the disorder, the inner opening is met with at a point not higher than an inch, or little more, from the anus; and it is not necessary to carry the incision higher into the rectum, even though the sinus may extend for some distance by the side of the bowel above the opening.

The operation is performed in the following simple manner:

The patient, who has had the bowels well cleared out previously both by castor-oil and by an enema, and who has been rendered insensible by chloroform, lies upon his side; an assistant separates the buttocks. The operator introduces his left forefinger, well oiled, into the rectum, and then passes a curved, narrow-bladed bistoury with a blunt point through the external opening, and carries it along the sinus until the point is made to enter the bowel through the internal opening, and to come in contact with the forefinger, the bulb of which is turned towards the orifice of the sinus. This being effected, the surgeon, by a kind of sawing motion with the hand holding the knife, and assisted by the left forefinger, pushing the instrument downwards, divides the whole of the structures between the sinus and the anus, bringing out both knife and forefinger together. In those cases where sinus is single, this one incision is alone necessary; but where there are one or more tracks branching off, the bistoury must be carried along them, so that the undermined integument may be fully opened and the wound made one.

If it has been ascertained that an internal opening does not exist, the knife must be forced through the mucous membrane into the cavity of the bowel at that spot where the tissue is found to be thinnest, and the operation should be then completed. It is not necessary to carry the knife to the very extremity of the sinus, if this extends to a considerable length, whether there be an inner aperture of the fistula or not.

After the operation is completed, a small strip of oiled lint should be placed lightly between the edges of the wound, but there should be no plugging or thrusting in of large pieces; a pad and bandage may then be lightly, yet firmly, placed over the parts; the patient should be kept quiet in bed, and should have a dose of chalk-mixture and laudanum, in order that the bowels may be confined; his diet should be such as not to cause much fæcal accumulation. At the end of three days, a dose of castor-oil should be given; and after the bowels are evacuated, the wound should be

cleansed and dressed again. A small portion of lint should be introduced from day to day within the edges of the wound; and if it look flabby, a solution of sulphate of zinc or of copper may be employed by means of the lint. In the majority of cases, if there be nothing adverse, the wound made in the operation will heal up soundly in two or three weeks. In some cases, however, without any appreciable cause, the healing process will be retarded; a useful remedy in such a case is the confection of black pepper, in drachm doses, every night; or it may be needful to send the patient away for change of air, when the wound, which has hitherto become stationary, will often commence healing again rapidly.

Before undertaking the operation for fistula, the surgeon should take especial care to examine the patient, not only locally, but as to the general state of health; for this disease is not unfrequently complicated with other morbid states, which may either render any cutting operation unadvisable, or may induce delay in order that some preparatory measures may be adopted. Thus it is well known that fistula in ano is not unfrequently associated with pulmonary disease; and if this be found to exist, it certainly would not be prudent to perform the operation, unless the suffering from the local affection should be very great, and the mischief in the chest be very slight. If the fistula be cut when the patient is suffering from phthisis pulmonalis, the wound, in the majority of cases, will not heal up, even though life may be spared for a considerable time.

There are other cases, also, where fistula is met with in persons who have had their health broken down by a long residence in hot countries, and have suffered from dysentery and disease of the liver; or cases are seen where either the liver or kidneys have become structurally altered by free indulgence in ardent spirits. An operation in such instances is generally to be avoided, unless there be some urgent reason for its adoption.

When a fistula is connected with a stricture of the rectum, a careful consideration of the case is required. If the obstruction be of a malignant nature, of course any operation is not to be thought of. It may, however, be somewhat difficult to ascertain at the early stage of the affection whether the stricture be of a malignant character or otherwise, and the fistula in connection with it may have been divided. In this case, either this wound will not heal, or its cicatrix will put on a scirrhous character.

I was called to see a middle-aged woman, who had been operated upon on two occasions for fistula, unsuccessfully, by a surgeon of large experience. On examination I found that the wound had only partly healed, and had taken on a scirrhous character. On examining the rectum, I found that there was a firm indurated stricture about an inch up, and there was much hardness about the parts altogether. I gave an opinion at the time, that it was a question whether the disease was not of a malignant character, although the features were not decided. At any rate, the ill success attending the operations for the fistula was due to the existence of the disease, which perhaps at the time was overlooked. I ascertained from a medical friend that this woman died six months afterwards, and that the disease had manifested itself as cancer.

If a fistula be complicated by a simple stricture of the rectum, and this latter be overlooked, the operation will in all probability fail. When the stricture is recognised, preliminary treatment is to be employed before the knife is used. The contracted part should be dilated by the bougie, and subsequently the sinus is to be laid open; during the after treatment, too, this use of the bougie must be strictly adhered to, otherwise contraction will recur, and the sinus will not close. When the inner opening of the fistula is situated above the stricture, this latter may be divided at the same time that the sinus is laid open; but it is better even in such a case to employ the bougie prior to the operation, if there be not any decided objection to this proceeding.

Every now and then a weakness or entire loss of power of the sphincter occurs after its division, more especially in those instances where two or three operations have been rendered necessary. In three instances which have lately presented themselves to my notice the operation had been repeated thrice in two of the patients, and twice in the other. In two out of the three the loss of power was complete; when

it is but partial, recovery may take place after the parts are thoroughly and soundly cicatrised.

In some rare cases there will be an external opening on either side of the rectum, with only one inner aperture. It then becomes a question as to what should be done. The operation performed on that side where the inner opening exists, together with slightly enlarging the mouth of the sinus on the other, will sometimes suffice ; but if this be found to be ineffectual, both the fistulous tracks must be freely incised. The objection to this double operation consists in the circumstance that loss of power over the sphincter may ensue. When there is a complete fistula on both sides, a double operation must be performed, and it should be effected on one occasion.

Ulcer of the Rectum and Anus.

Painful ulcer of the rectum, or fissure of the anus, is that where the ulceration is situated partly without and partly within the rectum. The existence of this form of ulcer is not unfrequently overlooked, because, although the symptoms are peculiar and striking, the pathological change causing them is not readily detected, unless by one accustomed to look for it. The patient who is suffering from this form of the affection will complain of having what he terms the piles; on questioning him closely, it will be ascertained that there is not any protrusion, but that he feels more or less acute pain in passing the contents of the bowels. This pain, instead of diminishing, increases in severity after the act, and lasts for a considerable time, varying from a quarter of an hour to four or five hours ; it then ceases, and there is no suffering until the bowels are again moved, when repetition occurs; and as time goes on the symptoms become more severe. There is also in some cases a flow of blood, and in all a more or less purulent discharge. On examination there will be nothing visible externally, with the exception, perhaps, of a small excrescence or pile about the size of a currant ; and this is found in a large proportion of cases of ulcer of the anus and rectum, and is a sign of great importance. On requesting the patient to protrude the parts as much as possible, and separating the sides of the anus very carefully, the ulcer will be seen situated at the base of the little tumour, which in nine cases out of ten is at the posterior border of the anus. In one case the ulcer may be only the eighth of an inch in length, and its extent may be defined by the eye alone ; in another instance it may be more than half an inch in length, and, extending beyond the verge of the anus, implicate the mucous membrane of the rectum itself. When this is the case, the limit of the ulcer cannot be seen, but it is necessary to introduce the finger into the rectum, when the peculiar and roughened sensation caused by the breach of surface is readily detected by a practised hand. This introduction of the finger is accompanied generally with excessive pain.

It is extremely important to employ the greatest care in the investigation of these cases ; for a small ulcer may be easily overlooked, in consequence of the rugæ around the anus enveloping the part and hiding it from sight. It is well, therefore, when this disease is suspected, to have a good light, and to take care that the examination be not made until the bowels have been well evacuated and the parts well cleansed With regard to the pathology of this affection, it is difficult to come to any correct conclusion. There is good reason to believe that, in all or most cases of spasmodic constriction of the anus, a diligent search would bring to light some slight ulceration or excoriation, on which the symptoms depend. One of the most recent authors of repute, Mr. Quain, holds the view that the sphincter is but secondarily or sympathetically affected, and that the painful spasm is not a disease in itself.

I think, perhaps, that I have more frequently met with this affection in women than in men ; and most certainly they are more liable to other morbid conditions which produce much the same kind of symptoms as those afforded by the painful ulcer. Amongst these I may mention the displacement of the womb, which pressing upon the rectum gives rise to a difficulty and pain in defæcation ; that painful condition of the coccyx which is the result of an injury, produces also very similar symptoms. I saw recently a very marked case of this kind, where an eminent

physician-accoucheur considered that an ulcer of the rectum existed, whereas, on examination, no such lesion was found, and appropriate remedies applied over the coccyx soon brought about a removal of the symptoms complained of.

The treatment of this affection consists either in the employment of local agents, or in the use of the bistoury. In those cases where the ulceration is only of slight extent, is not carried far within the sphincter ani, may be comprehended by the naked eye, and the symptoms have not long existed, a cure may be brought about by careful attention to the bowels, by the employment of rigid cleanliness, and by an occasional application to the ulcerated spot of the solid nitrate of silver or sulphate of copper. After the sore has been touched once or twice, the effect will be, in those cases which are benefited by this treatment, a considerable mitigation of the severe pain which has troubled the patient when at the closet and afterwards; and the sore, instead of presenting the greyish appearance which is usually observed, puts on healthy granulations, and slowly contracts in size. In order to assist this process, a lotion of sulphate of copper or sulphate of zinc, one grain to an ounce of water, should be applied two or three times a day; or if these do not succeed, the ordinary black wash may be used with benefit. The daily introduction of a full-sized bougie, made of wax or of yellow soap, will sometimes act beneficially, by distending the sphincter and producing such an amount of irritation as will set up a healing process in the sore.

In the more severe cases, however, this local treatment will fail to produce a cure; and there are some persons who have been brought to such a state of suffering, local and general, that it will be unwise to trust to measures which either may not succeed, or which may be slow in giving relief. A modification of the operation which was originated by the French surgeon Boyer, and which consisted in the division of the sphincter and the tissues around, is now generally undertaken by the best surgeons, and is found to be successful in remedying this affection.

The operation itself is simple and easy of execution. The bowels having been well cleared out previously by a dose of castor-oil or an injection, the surgeon should then take a straight narrow-bladed, *probe-pointed* knife, and having passed his left forefinger into the rectum beyond the extremity of the ulcer, he should introduce the point of the knife very carefully, and commencing his incision above the ulcer, carry the cutting edge fairly and quickly through the centre of the sore or fissure. It is absolutely necessary to include the whole length of the sore, and not to cut to one side; and therefore it is well that an assistant should open the orifice of the anus as far as possible, in order that a good view of the greater part of the ulcer should be obtained by the operator. There is very frequently a small external pile or thickened fold of integument at the base of the sore; this should also be removed, as well as any other pendulous flaps of skin which may encircle the anus. Scarcely any dressing is required after this operation; a small strip of lint dipped in oil may be introduced, and kept in for a day or two, but it is not necessary. It is as well to give an opiate after the operation: in the first place, to lessen pain; and secondly, to prevent the action of the bowels, which should not be allowed for two days or more; and then this action should be produced artificially by a dose of castor-oil. The wound should be daily dressed with a dossil of lint dipped in a weak solution of sulphate of zinc and water. This dressing is not absolutely necessary; but there are some cases in which the wound becomes sluggish, and then a slight stimulation is desirable. The use of the confectio piperis nigri will assist the healing of the wound after this operation, as after that for rectal fistula.

It is very necessary to make a careful examination of the rectum at the time of operating, for it is very possible that a polypoid growth will be found to exist in conjunction with and above the ulcer, and which may easily escape observation. I have quite accidentally discovered these growths more than once lately after I had completed this operation, and had introduced the finger high up into the bowel for the purpose of passing a suppository. If one or more of these growths were left behind, it is probable that the cure would not be complete, or at all events their presence might produce a return of the ulceration; for I believe that not unfrequently it is the presence of this polypoid growth that originates the fissure or ulcer.

It is necessary here to refer to a morbid condition which not unfrequently exists in combination with this painful ulcer, and which may be easily overlooked, viz., *internal fistula*. When this exists the small ulcer will in reality constitute the opening, and if a probe be introduced it will travel upwards, under the mucous membrane, for an inch or two, or it sometimes can be passed downwards towards the outlet under the external sphincter. In these cases, there is, in addition to the peculiar pain, a considerable amount of discharge—the existence of this should at once excite the attention of the surgeon. If a channel exists not only must the ulcer be divided, but the whole sinus is to be laid open. I have met with several cases where a neglect of this important step has rendered the whole operation a complete failure, and where, on laying open the sinus, a cure of all the symptoms has been effected.

It has lately been recommended in France that an operation effecting the same purpose as division of the ulcer should be performed. This consists in the forcible tearing open of the sphincter by the introduction of the two fingers into the anus, and using extension. There has been sufficient evidence placed before the profession to prove that this mode of dealing with fissure of the rectum is attended with success; but it is a proceeding so rude and unsurgical, that we trust the surgeons of this country will not forsake the simple and effectual means we have described when any operative measure is required.

Stricture of the Rectum.

This disease consists essentially, in most cases, of an adventitious deposit thrown out upon or around the coats of the intestine. In the most simple form of stricture, there is a more prominent ring of apparently hypertrophied mucous membrane, either entirely or only partially surrounding the cavity of the gut. A careful examination on the living body with the finger, and an investigation of the diseased part after death, shows that the thickening is produced in the areolar tissue underneath the mucous membrane; although there are preparations to be met with which lead to the belief that the encroachment upon the cavity of the gut is caused merely by a prominent fold or ring of the mucous membrane itself. In the more marked cases of the disease, not only is the deposit found in the submucous cellular tissue, but there is a thickening of the muscular coat as well, produced, not by hypertrophy of this investment, but by an infiltration of the fibrous exudation through the meshes of the muscular texture. In the more severe cases, where the disease has lasted for a long period, this fibrous deposit becomes more extensive and dense. In most cases there is, together with a very narrow contraction, a large amount of thickening of the coats of the bowel; but every now and then a considerable amount of contraction is found without any, or with scarcely any, consolidation of the surrounding tissues. In one very interesting preparation in the Museum of St. Bartholomew's Hospital, there is a tight contraction of the gut about three inches from the anus, the cavity being diminished to about one-quarter of an inch in diameter for the extent of an inch; but there is not any thickening of the tissues whatever, and the contraction is supposed to be owing to muscular action. In some rare instances, the stricture is caused, not by any deposit in the walls of the gut, but by fibrous bands running across the cavity of the bowel; thus, in King's College Museum there is a curious specimen, which shows a stricture about one inch and a half from the anus, consisting of a cup-shaped septum, formed of thick bands running across, in which are three or four distinct openings which would each admit a small quill.

In a few instances, the fibrous deposit producing the thickening—which is the essential feature of the disease—involves only a portion of the circumference of the bowel, as was found in a case of stricture of the rectum lately brought to me for consultation. In by far the greater number, however, the whole circumference of the gut is implicated in the condensation which has taken place. It may be much more decided on one side than another.

The extent of bowel affected lengthwise also varies much. The disease may

involve only one or two lines of the gut; much more frequently the deposit extends from half an inch to an inch and a half in length; sometimes the consolidation implicates three or four inches of the intestine; and, in rare cases, there is a general thickening of the tunics, involving nearly the whole of the rectum, and producing a considerable diminution in the cavity of the bowel.

The pathological changes which occur as the result of stricture of the rectum affect the bowel in the immediate locality and behind it; important results are also witnessed in the tissues surrounding or in connection with the bowel.

The intestine immediately above the stricture is, in the majority of cases, more or less dilated; in one instance the cavity being widened only to a small extent, whilst in another, where the stricture has been very tight and of long duration, the intestine is distended in a great degree; thus in one specimen in the Museum of Guy's Hospital, the rectum is five inches in its diameter. There is also a thickening of its tunics above the part immediately diseased, in a great measure owing to an increase in the development of the muscular coat; the law being followed here, that if there be any obstruction to the passage of the contents of a muscular organ, the increased energy necessary will be marked by an increase in the size and strength of the muscular fibres. The mucous membrane above the stricture is generally in a diseased condition, being either preternaturally vascular and thickened, or, in long-standing cases, superficially or deeply ulcerated, and sending forth a copious unhealthy discharge. Below the seat of stricture there is not much alteration of the parts; the mucous membrane is, however, sometimes found to be inflamed and thickened, or even ulcerated; and there may be thickening and induration of the coats of the intestine, the result of inflammation and suppuration extending from the immediate locality of the stricture.

In addition to these morbid phenomena, which are usual, other serious changes are occasionally seen in connection with stricture of the rectum. Thus the irritation of the disease may produce inflammation and suppuration in the tissues surrounding the bowel; one or more abscesses may form, and communicate not only with the bowel at separate points, but open upon the surface near the anus, or in the front of the perinæum. Sometimes a communication exists between the rectum and the vagina or the urethra, and more rarely an aperture forms above the stricture, between the bowel and the cavity of the peritonæum.

The connection between stricture of the rectum and fistula, as one of its results, is an important one; the two diseases are by no means unfrequently met with together. It is supposed by some authorities that the fistulous opening in the bowel is generally seated beyond the stricture, and that the morbid change is owing to the obstruction and subsequent mischief produced by the stricture; whilst others, among whom is Mr. Syme, are of opinion that the fistulous opening is not owing to the resistance which is offered by the stricture. It is a fact, however, that the opening is not unfrequently found behind the stricture, and that sometimes it is situated lower down. In a preparation lately inspected by me, where fistulæ were associated with a stricture of the rectum, there was an opening into the bowel above the obstruction, and one situated below the stricture. In another specimen, a fistulous sinus runs up along the side of the gut for half an inch above the stricture. In a patient lately seen by me, where the two diseases were associated, I found, on examination, that the fistulous sinus opened into the bowel just above the stricture. In some of these cases there can be little doubt that ulceration of the mucous membrane is the first step in the formation of fistula; whilst in others suppuration in the surrounding cellular tissue, and subsequent formation of the sinuses, is the correct pathology.

With regard to the seat of stricture of the rectum, it is found that one particular locality is more disposed to the disease than another. Thus in by far the majority of instances, the contraction is met with at the lower part of the rectum, about an inch or an inch and a half from the anus. Observation on the living body proves this; and the result of my examination of the morbid preparations in the various museums was to show that, in very nearly one-half of all the specimens, the stricture was

found to exist at a point about an inch distant from the orifice. Next in frequency to this part, the disease is met with at a point varying from two to three inches from the anus; it is occasionally met with at four or five inches; and sometimes the contraction involves that part of the gut which marks the junction with the sigmoid flexure of the colon.

The symptoms which are produced by a stricture of the rectum vary according to the extent and peculiarity of the disease. In some rare cases, even when the obstruction has lasted for years, and has materially narrowed the canal, none of the usual symptoms referable to this disease have been experienced until a short period before death, or an examination after death alone has revealed the true nature of the malady. Usually, however, there are well-marked symptoms. In some instances the patient can trace the commencement of his disease to a particular time, when he will inform us he suffered more or less severe and persistent pain in the lower part of the abdomen, which was followed by great irregularity of the bowels, necessitating the use of aperient medicine; diarrhœa has probably supervened, the motions being tinged with blood; and this has been followed by constipation, preventing almost entirely the natural action of the bowels.

As the disease advances, the constipation increases, and there is a sense of obstruction about the rectum, which causes the patient to strain violently whilst at the closet; the fæces are passed in small quantities at a time, and are much diminished in size, as the bowel becomes more contracted; the general health begins to suffer from the retention of fæcal matter in the intestines; the abdomen becomes distended; there is marked dyspepsia, with a loaded tongue and general lassitude; and the patient loses his natural appearance of robustness The local symptoms also become more severe; there is a continual uneasiness about the rectum; considerable pain attending the passage of the fæces, which is effected two or three times in the twenty-four hours, in a liquid form; the bladder becomes irritable; pain is felt in the loins and down the thighs. Occasionally, a large accumulation of fæcal matter having taken place above the stricture, there will occur suddenly from time to time a violent attack of diarrhœa, followed by the most obstinate constipation. In advanced cases, one very troublesome symptom consists in the excoriation and ulceration which is produced around the anus by the acrid discharge which takes place from the seat of the stricture. In some cases this discharge is very abundant at the time the patient is at the closet, and is one of the most important diagnostic symptoms.

Although the general health in many cases of stricture of the rectum does not suffer much at first, the disease will, if unchecked, destroy life gradually by the local irritation and suffering, and by the impairment to nutrition almost surely following from constant and long-continued obstruction to the passage of excrementitious matters. In other cases the patient dies suddenly, from symptoms of acute obstruction and inflammation of the bowels, the strictured canal becoming blocked up either by an accumulation of hardened fæces, or by some foreign body. In one remarkably interesting preparation in the Museum of the College of Surgeons, a stricture of the rectum which had existed for years had suddenly become entirely closed, lymph being produced by the irritation of a fishbone which had been swallowed, and which had become arrested at the contracted part.

When the stricture is situated, as it usually is, within two inches of the anus, it is readily felt by the finger, which should be well oiled and carefully passed, because in many cases great pain is experienced by the patient. When the stricture is but slight, involving a small extent or a portion of the circumference of the bowel, the diagnosis will not be so easy as is imagined; when, however, the stricture, as is for the most part found, has encroached on the cavity of the rectum to some extent, the finger readily detects it; for its point becomes entirely arrested by the dense and hard obstruction, or it can only be just insinuated through the diseased part. When withdrawn, the finger is generally covered with a muco-purulent secretion, if the case is at all advanced.

If the symptoms are well marked, and yet the finger cannot reach the obstructed

point, it will be necessary either to make the patient strain violently, or to examine him whilst in the upright posture; in this way a stricture which is situated beyond the reach of the finger in an ordinary examination, may be discovered. Should this fail, a wax or gum-elastic bougie, about as large as the adult forefinger, and well oiled, should be carefully introduced up the rectum. This measure, however, is rarely necessary for the mere purpose of diagnosis, and is open to several sources of fallacy.

In making an examination of the rectum, the surgeon must bear in mind that it may be pressed upon by bodies external to the bowel. An abscess of the prostate gland, especially if of a chronic nature, will so press upon the rectum as to contract its cavity and prevent the passage of the contents of the bowel.

I had a patient at the Westminster General Dispensary, aged 25, who applied with symptoms of obstruction of the bowels; nothing had passed for a week, and he was in continual suffering, and had become very much reduced in health. On examining the rectum with the finger, I found that the cavity of this gut was almost closed by a large elastic tumour situated in front. The patient had not had any gonorrhœa, but about a month since a catheter had been introduced, and had caused severe pain and bleeding. Since then he had complained of pain and weight about the rectum, and the constipated condition of the bowels alluded to had occurred. I suspected that there must be a chronic abscess mechanically preventing the passage of the fæces, and therefore passed a bistoury into the bowel, and made a free incision into the tumour; a large quantity of matter was evacuated, with great relief. The patient was ordered a dose of purgative medicine; this acted freely; and all symptoms of obstruction soon passed away.

The enlarged prostate itself in old people may so press upon the rectum as nearly to obliterate its cavity; the uterus may be retroverted, or a solid tumour growing from that organ may so press on the bowel as to cause the symptoms of stricture. We have seen that the essential pathological feature in stricture of the rectum is a fibrous deposit in or between the tissues of the bowel; and there can be no doubt that the chief instrument in the formation of this product is inflammation of the coats of the intestine of a more or less chronic character. The causes of the inflammation leading to the formation of stricture are various: spontaneous inflammation of the mucous membrane may arise; or the habitual presence of hard fæcal matter, exciting frequent attempts to evacuate, will produce it; foreign bodies lodging in a portion of the rectum for a continuous period will bring about the same result. Muscular contraction may cause stricture. I have alluded to one specimen where this, with very good reason, is supposed to have been the cause. Some of the most severe instances of stricture of the lower part of the rectum, or, more properly speaking, of the anus itself, are produced by the cicatrisation resulting from wounds made by the scissors in the removal of external piles, especially if the precaution be not taken to excise only the superabundant textures.

Sometimes, in these operations, large portions of skin, as well as circular fringes of mucous membrane, are cut off; the consequence is, the formation of a tight contraction at the anus. I met with an instance of this kind in the person of a lady who had been operated upon for external piles by one who did not understand his business. Such a tight and unyielding contraction occurred as nearly proved fatal; and the only manner in which life could be rendered at all comfortable was by passing a bougie daily, for the patient would not permit me to divide the stricture.

A by no means infrequent cause of stricture of the rectum is ulceration of the mucous membrane of the bowel, terminating in cicatrisation and subsequent contraction of the cavity of the intestine. This is occasionally witnessed in those persons who have lived a long time in India, and have suffered from dysentery. Direct injuries to the bowel will produce stricture, such as the operation for fistula, or the infliction of a wound by means of a bougie or an enema-pipe.

There is one cause, however, of stricture of the rectum which is almost entirely overlooked by the majority of writers, in this country at least. I allude to the venereal poison. As a direct consequence of the application of the poison to the part by means of unnatural intercourse, it is doubtless extremely rare in England; but as one of the sequelæ of syphilis, and as one of the indications of constitutional taint, I believe it is not unfrequently met with. Independent of other instances,

two well-marked cases of stricture of the rectum occurring in respectable married women, who had suffered severely from constitutional syphilis, have lately been under my care. In either case the disease distinctly ensued after the venereal poison had been received into the system. Mr. Henry Lee has informed me that he has lately seen three cases of secondary syphilitic stricture of the rectum. Mr. Partridge assured me that he had a case in King's College Hospital where there could be no doubt that the disease was produced by unnatural intercourse. Bushe, in his valuable work, says: 'Venereal ulceration of the rectum may arise from direct application of the venereal poison; or it may be consecutive to disease in the genital organs, and then co-exists with other secondary symptoms.'

The treatment of stricture of the rectum must be conducted upon the same principles as obtain in the employment of remedial measures for stricture of the urethral canal; and in the first place it must be stated that the surgeon can rarely cure, in the full sense of the word, an organic stricture of the rectum, but he can remedy it in a great measure, prevent its increase, and thus ward off those secondary ills which, almost necessarily, ensue if the original disease be neglected.

The great object the surgeon has in view is to remove the contraction, and to restore the calibre of the gut as nearly as possible to its natural condition. This can in a great measure be effected by the employment of dilatation in the majority of those cases which are situated within the reach of the finger, and where the primary and secondary morbid changes have not proceeded to a serious state. The agent employed is either the bougie, or some other mechanical contrivance for acting on the stricture as a dilator. The bougie which is most generally used is either made of wax, of gum-elastic material, or of metal. As, in the treatment of strictures of the urethra, various surgeons prefer particular kinds of dilators, so it is in dealing with stricture of the rectum, although one form of instrument may be as useful as another. The wax bougie is a most admirable instrument in the slighter forms of stricture of the rectum, where much pressure is not required; it is also a good form to employ in cases where considerable pain is experienced on the introduction of the finger, or where, from the existence of much muco-purulent or sanguineous discharge, ulceration of the mucous membrane is suspected. It is important to be very particular in cleaning bougies after use. The gum-elastic bougie is the one, perhaps, which is most generally useful when well made. It is sufficiently firm to compress the stricture well, and yet elastic enough to yield to any obstruction through which it is not intended to pass. The metallic bougie, which is a short cylinder attached at pleasure to a handle, is especially useful in narrow strictures attended with a large amount of induration and situated close to the anus.

When the stricture is seated beyond the reach of the finger, the use of the bougie is attended with more difficulty, as there is no certain guide to the exact position of the stricture, or to the size of the instrument which it will admit. With very great care, however, the surgeon may dilate a stricture when it is situated several inches beyond the anus with safety; but it must be borne in mind, that the folds of the bowel or the prominence of the sacrum present themselves as obstacles, which may be mistaken for stricture. And the greatest possible care should be taken not to do mischief; it is a well-known fact that in several cases the walls of the gut have been penetrated by the bougie even where there has not been any stricture in existence.

It has been stated that, in certain instances of stricture of the rectum, there has been a venereal origin; and when this can be pretty clearly made out, the local treatment should be assisted by the exhibition of small doses of mercury and iodide of potassium; the general health will be improved, and we may expect a more speedy absorption of the morbid product constituting the stricture. It will be well also, instead of using oil, to smear the bougie with the strong mercurial ointment.

Incision of the strictured portion has been practised by some surgeons; and, as an adjunct to dilatation, it is, in certain instances, a useful means. It is not, however, free from danger. A case came under my observation a short time since, in which death ensued upon the division of a stricture with the knife, and several

similar cases have been recorded. This procedure, therefore, should not be adopted unless there is a necessity for it.

Incision is necessary in those cases of stricture, rarely met with, which are of traumatic origin, and situated at the verge of the anus, or within a very short distance; there is generally a dense cicatrix and much induration around, so that dilatation by the bougie is painful and difficult. It is also advisable, if not actually necessary, in old-standing instances of the disease situated in the usual locality and arising from the usual causes, but where, from neglect and continual irritation, the induration around has become excessive, and the stricture most unyielding to the bougie. In either case the operation is best done by introducing the left forefinger into the rectum, and guiding upon that a straight, blunt-pointed, narrow bistoury, with which the stricture is to be divided. Deep incisions must not be made, but the stricture should be simply notched at several points of its circumference. A bougie should be introduced immediately for a minute or two; a suppository of opium is then to be passed into the rectum; the patient must keep quiet for two or three days, when the bougie is to be employed, and continued at regular intervals. In this manner a stricture which previously had defied all attempts to dilate it, will be so far reduced that the patient may obtain great comfort.

A stricture of the rectum when once fully formed, is seldom or never thoroughly cured, even under the most assiduous care. There is the same tendency to re-contraction here as in instances of stricture of the urethra; therefore, when the disease has been brought under subjection, it will be absolutely necessary to keep up periodical dilatation; this may, however, be easily effected in the majority of cases by the patient himself. In some cases once a week will suffice; where, however, the disease has been traumatic, it will be needful to pass a bougie every day, or every other day, to prevent re-contraction.

When sudden obstruction of the bowels takes place in an instance of stricture of the rectum situated high up beyond the reach of the finger, the patient is placed in the most formidable danger, for it is impossible to ascertain the nature of the obstruction. I have referred to one preparation in the Museum of the College of Surgeons, showing a stricture of the rectum situated near the colon, which had become suddenly closed by an effusion of lymph, the result of a fish-bone sticking in the stricture.

In such cases the long tube must be carefully passed, and the obstruction may be overcome; a large quantity of warm water should then be thrown up. If, however, it is found that the tube cannot be passed, and the use of powerful purgatives is of no avail, death will be imminent; and the only chance of obviating it will consist in making an opening into the colon, either by the method adopted by Littre in the groin, or that suggested by Amussat. The latter operation is that which is usually selected; there are a few cases on record where life has been preserved, and there are instances in which the surgeon is undoubtedly justified in resorting to this expedient.

Cancer of the Rectum.

In considering the subject of stricture of the rectum, that form of the disease only has been alluded to which is the result of simple inflammatory thickening: there is, however, another condition, where more or less obstruction to the calibre of the bowel is produced by growths which are essentially of a malignant character, whereby the constitution is contaminated, and which render the local disease much more formidable than the simple stricture. The features of distinction between these two particular kinds of the affection are generally pretty broadly marked, and, indeed, cannot well be confounded, when the one we are considering has become fully developed.

Cancer may attack any part of the rectum, but it is perhaps most generally met with in the lower portion; so that in a large number of cases the disease is within the reach of the surgeon's finger, and its character may be readily appreciated. In the very early stage of the disease it appears to commence as a hard deposit between the

coats of the intestine; the deposit in some instances consisting of distinct nodules scattered here and there over the bowel; in other cases there will be a complete circle formed by the disease. The actual seat of the deposit is in most cases the areolar tissue, between the mucous and muscular coat. As the disease advances, this is more distinctly ascertained by the circumstance that the mucous membrane, in a more or less healthy condition, is raised up by the deposit underneath it; in course of time, however, this membrane becomes ulcerated, generally in the centre of the deposit.

In more rare instances the malignant deposit is situated between the muscular and serous coat of the bowel, and the morbid growths penetrate into and between the fibres of the muscular tissue. A general thickening and induration of the whole structure of the bowel takes place, so that when a section is made it is impossible to distinguish one texture from another. By this means the cavity of the bowel becomes encroached upon, much in the same way as when the simple fibrous thickening takes place.

As time advances and the cancerous growth increases, the cavity of the intestine becomes encroached upon to a greater extent by the formation of one or more tumours, or nodules, which project into the bowel; by-and-by ulceration of their surface takes place, and in some instances there will be found blended together a large hard nodule of cancer, and a distinct fungous growth with a bleeding ulcerated surface. The morbid growths increase upwards and downwards, and involve the rectum to the extent of four or six inches, and spread towards the orifice of the bowel, and appear there as warty growths or masses of fungoid disease. It not unfrequently happens, however, that there is a small portion of the bowel perfectly healthy between the anus and the deposit.

All the different varieties of cancer are seen to involve the rectum; of these, however, the true hard scirrhus is that most frequently met with. Encephaloid and epithelioma are not unfrequent, and colloid cancer is occasionally seen.

The symptoms which attend upon malignant disease of the rectum vary much, both according to the stage of the malady and the particular effect the deposit has upon the cavity of the bowel. At the outset the patient complains of an uneasiness about the lower part of the bowel, and an interruption to its proper functions; the fæces passing with more difficulty than heretofore; diarrhœa occasionally intervening, accompanied with bloody mucus, and this latter symptom becomes more and more prominent. Thus at first the symptoms are those which depend upon ordinary stricture of the rectum, and the more especially as in some instances there is very little disturbance of the general health. As the disease advances, however, there comes on a greater difficulty in voiding the fæces, the act is accompanied with considerable pain, and at each time the bowels are moved there is a discharge of blood. As in ordinary stricture, there is great distension felt, which is now and then relieved by a profuse diarrhœa.

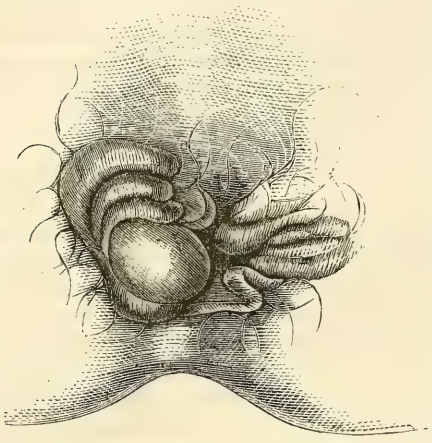
The general health at first is but slightly affected; but as the disease advances, its effects on the constitution become marked; the patient complains of indigestion and flatulence, and of an indescribable depression. His face becomes anxious—presents the peculiar dull aspect of one suffering from malignant disease; and emaciation takes place. The patient is deprived of rest; and indeed there can be few more pitiable objects than some of those who are suffering under cancerous disease of the rectum.

In course of time, the gut becoming more narrowed, and the surface of the diseased textures getting into an ulcerated state, there ensues of necessity a greater hindrance to the passage of the fæces; painful attempts are constantly made to pass them, and these efforts are accompanied with an acrid sanious discharge, mixed with fæculent and muco-purulent fluids. And frequently this action comes on without the patient having the least control over himself. As the disease involves the surrounding tissues, abscess forms by the side of the bowel, and degenerates into fistula. And when the deposit encroaches upon the bladder, there is either great irritability of that organ, or daily retention of urine; this latter symptom may

be produced by the impaction of fæcal matter in the urethra. I have lately seen a preparation where a fatal retention of urine proceeded from this cause.

Death generally follows this disease within three or four years after its symptoms are marked. And it is produced either by a gradual sinking of the powers of life, or by the sudden coming on of an attack of obstruction of the bowels.

Fig. 175. Cancerous Growth, protruding at the Anus, surrounded by external Piles.



When the disease has existed for some time, and is not situated high up in the bowel, the surgeon can have little difficulty in forming a correct diagnosis; and in many cases there is more or less scirrhous induration at the orifice of the anus, or the disease protrudes externally in the shape of a fungoid mass. In the early stages, however, it is not easy to recognise the true nature of the malady. If the growth be within the reach of the finger, it will be felt as an indurated ring, encircling, or partially encircling, the bowel, as when a simple stricture exists; but in the scirrhous disease the hardness is much more decided and more extensive, the discharge also of a more offensive and sanious character than it is in the earlier stages of the simple stricture. It may, however, be difficult notwithstanding to ascertain the true nature of the malady at its outset; therefore a cautious opinion must be given.

I saw a patient, about 40 years old, who was operated upon twice for fistula, neither operations succeeding. On going to see her after the last had failed, I made a careful examination, and discovered a stricture at the lower part of the rectum. I am not aware that there had been any suspicion of malignant disease, and the only reason which made me suspect its existence was the circumstance of the induration being very decided and extensive. I gave a cautious opinion, inclining rather to the view that the disease was malignant. This patient has lately died with cancer of the rectum. I may mention that the surgeon who operated upon the fistula was a man of large experience and great skill.

The *treatment* to be adopted for malignant disease of the rectum can offer no other service, unfortunately, than that of palliating the disease, assuaging pain, and prolonging the duration of life. We have seen that, in instances of simple stricture of the rectum, the affection may be cured, or at all events kept under control, by the careful employment of proper surgical means and appliances; because the deposit forming the contraction is merely the result of inflammation, and thus may be absorbed or much diminished by the use of pressure; and moreover, the general constitutional health is not affected as when the disease is of a cancerous nature. Relief, however, can be given to those unfortunate persons who labour under the latter complaint; and it is important to inquire what are the measures best calculated to produce that relief.

There is a difference of opinion amongst surgeons as to whether the employment of dilatation is proper. As a rule, it may be stated that bougies should not be used in malignant stricture of the rectum; but it is unwise to discard them entirely. When the disease is met with in its early stage, has not ulcerated, is within reach of the finger, and is producing much contraction of the calibre of the bowel, a wax bougie well oiled may be passed gently through the contracted part; and its use may be repeated once or twice in the week, if pain be not produced. In a case of extensive cancer of the rectum which had not ulcerated, I employed the bougie in this manner for a long period with the effect of giving relief. It is not to be expected that any absorption of the diseased tissue should take place beyond that which is deposited in connection with cancerous stricture as the mere result of inflammatory

action. When, however, the disease has advanced to the ulcerative stage, it would be highly imprudent to use bougies.

The main object in the treatment is the alleviation of pain; and this is best effected by the use of anodynes exhibited in the shape of suppositories made of pil. saponis comp. or of morphia mixed with extract of hyoscyamus, in the proportion of half a grain of the salt to ten grains of the extract. This should be introduced each night into the rectum, and in the course of time the strength of the anodynes must be increased. I have seen very great relief given to the patient for many weeks by the use of this suppository. As the disease extends, and involves other parts, the suffering is much more severe, and it will be found necessary to give opium by the mouth as well as by the rectum, in order to produce a mitigation of pain.

The bowels are to be unloaded by the occasional use of aperients, and, when there is not much irritation caused, by the exhibition of enemata of warm water. In order to soothe the ulcerated and painful parts, injections of tepid oil or of decoction of poppies must be used from time to time: the surgeon must not forget to take great care in the introduction of the enema-tube, as serious mischief may soon be effected.

During the time the malady is running its course, the strength of the patient, which will gradually decline from day to day, must be supported by those articles of diet which contain the most nutriment in the smallest bulk, and which leave but little fæculent matter in the intestines; and it will be needful to avoid as much as possible vegetables and bread. The profuse sanious and foul discharge which sometimes accompanies this disease may be checked by an injection composed of sulphate of copper and opium, or a very diluted lotion of solution of chloride of zinc may be employed with benefit.

If sudden and complete obstruction of the bowels should occur during the course of this disease, it will be a question as to how far the surgeon is justified in making an artificial anus. If this accident happens in the last stage of the disease, when the patient is much exhausted by previous suffering, I do not think that the operation should be performed; but if the obstruction, which must be fatal, should occur during the earlier course of the affection, and before the constitution of the patient has been much impaired, the surgeon is only doing his duty if he recommends a proceeding which, although in itself surrounded with difficulty and danger, may yet prolong life for several months at least, and allow the patient to die at last in comparative ease. Some surgeons were, a few years since, in the habit of performing excision of the lower part of the rectum when affected with cancer. Mr. Harrison Cripps has paid great attention to this subject, and is an advocate of the operation, and, in his work recently published, has shown that in certain cases great benefit may be accomplished by the operation. It is, however, one surrounded with so much danger and difficulty that it is only, I think, in rare instances, where the disease is limited to the lower two inches of the bowel, and where the finger can be got well behind the diseased part, that the surgeon is justified in performing it. The operation may be effected by the knife alone, which is the most speedy and perhaps the best method, or, after the incisions have been made, the écraseur may be used to separate the growth, or the thermo-cautery: by this means loss of blood may be prevented.

In one case I removed the lower two inches of the rectum for a scirrhous tumour; it was in the person of a woman aged 60, otherwise in good health. The growth was well defined, and could readily be commanded by the finger introduced into the vagina. The mucous membrane of the vagina could be freely moved over the growth; and, although it extended into the ischio-rectal fossa considerably beyond the anus, implicating the skin and anal orifice to such an extent as almost to close it, still it was quite circumscribed; and under these circumstances I did not hesitate to remove it in the following manner. I introduced the finger into the rectum, carrying its point to the top of the coccyx. I then introduced a sharp-pointed curved bistoury along the finger to the median line posteriorly, and cut outwards. I then made an incision through the skin about an inch from and on each side of the anus, carrying them forward until they met at the posterior part of the vagina. The bowel was carefully dissected away from the vagina, and isolated with the knife; the finger during this dissection being kept in the bowel, upon which traction was made. Very free hæmorrhage took place during this part of the proceeding. In order to check this, and at the same time

complete the severance of the bowel, I used both the cutting and serrated cautery employed by me in removing hæmorrhoids. The vessels which bled were thus secured, and the edges of the severed bowel were stretched to the integument on either side and behind, and a drainage-tube left in.

The patient lost a very large quantity of blood, and remained for some time in a state of collapse, but she soon rallied, and received great comfort from the operation.

Polypus of the Rectum.

Polypus of the rectum is not unfrequently seen by those who have large opportunities of studying the affections of this portion of the intestinal canal. It is met with in various forms, and it is important to be acquainted with the disease, inasmuch as it often produces most severe symptoms, and at the same time is easily remedied.

The most simple form in which a polypus is seen is where there are one or more short processes, as it were, of the mucous membrane standing out prominent in the cavity of the rectum. These bodies, if they may be so termed, produce little uneasiness, and are generally only accidentally discovered when the surgeon is making an examination of the bowel with the speculum for some other disease. They are usually situated above the sphincter, cause very little inconvenience, and therefore do not demand the attention of the surgeon.

The soft gelatinous polypus, like that growing rom the mucous membrane of the nostril, is very rarely indeed met with : but it is not an unfrequent occurrence to observe a polypus which grows from the mucous membrane of the rectum about an inch from the orifice. It varies in length and thickness, being from half an inch to two inches in length, and as thick as a crow-quill or as the little finger. This form of tumour is of a reddish-white colour, firm in texture, and attached to the mucous membrane sometimes by two distinct stalks ; or it may have only one attachment and a bifurcated extremity. On examination this form of polypus is found to be fibro-cellular in structure, and very slightly vascular. In one specimen of this fibrous polypus, which I lately removed from the mucous membrane of the gut just within the verge of the anus, some curious microscopical appearances were observed. The structure was principally fibrous, but the mucous covering was arranged so as to form a number of very distinct villous processes. It looked like a piece of small intestine; lacteals could be seen in the villous processes, and their trunks could be followed for some distance into the tissue of which the tumour was composed.

When seated high up, this polypus does not produce much uneasiness ; but most generally it is attached to the bowel so near to the anus, that when the patient is at the closet the extremity of the tumour protrudes, and perhaps becomes gripped by the sphincter, and in this manner very annoying and painful symptoms are produced. Sometimes even the polypus protrudes when the patient walks about ; great irritation exists ; there is a discharge of mucus, sometimes of a little blood ; and the patient is obliged to wear a support, which gives ease. He is conscious of some foreign body at the anus, but the symptoms are usually attributed to piles.

The only efficient treatment for this kind of polypus is to remove it ; and as there is so little vascularity, it may safely be taken away by the scissors, especially when the tumour is very near to the anus ; for if there be any hæmorrhage, it is easy to stop it. When the polypus is situated an inch or more above the anus, and the base is at all broad, the tumour should be well brought down by an injection previously given, and a thread can be tied tightly around the base before the growth is snipped away. In several cases, however, where I have cut these fibrous polypi away without first tying them, there has only been a very slight amount of bleeding subse quently.

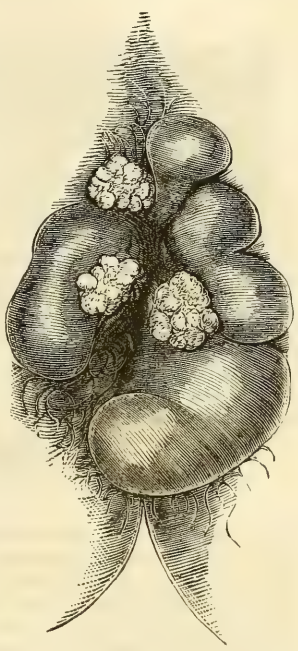
A form of polypus very rarely met with is where the growth is warty.

I lately saw a gentleman of middle age, who consulted me for prolapsus ; and on coming to examine him, after making him protrude the parts well, I found attached to the base of the prolapsed portion, about an inch from the verge of the anus, a curious-looking mass, composed of an aggregation of small lobes arranged upon a peduncle, just like a bunch of

grapes. This polypus, if it may be so termed, was an inch in length, of a reddish-white colour, and it protruded at the centre of the anus. I removed this growth; and on microscopical examination its texture was chiefly or entirely epithelial, in fact it might be considered as a warty growth.

The *vascular* polypus is, perhaps, of most frequent occurrence; it is chiefly met with in young children. The tumour varies in size from a cherry to a pea; is of a bright red colour; its structure is fibro-cellular, and eminently vascular. It is either situated within a short distance of the anus, or it may have its attachment one or two inches up the gut, by means of a long narrow stalk. The symptoms which this form of the disease produces is the prolapse of the tumour on the child evacuating the bowels, and hæmorrhage of a more or less profuse character. This bleeding not only takes place when the child is at the closet, but it will persist afterwards, when he is running about. The occurrence of this loss of blood in a child should lead to a close examination of the rectum for polypus; for if the tumour be attached high up, it will recede immediately after the action of the bowels, and escape observation. It is necessary, therefore, to make the inspection immediately after the evacuation of the contents of the rectum either by medicine or an enema.[1]

Fig. 176.—Warty Polypi at the Anus.



The treatment which should be adopted is simple, and merely consists in the removal of the polypus, either by twisting it off with a pair of forceps, or placing a ligature around the pedicle, and returning the tumour within the bowel and allowing it to slough off. Excision should not be resorted to in these cases, as there might be a considerable amount of bleeding, which would be especially prejudicial in a young child.

A rare form of polypus of the rectum is occasionally met with in adults, when the tumour reaches a size as large as an egg; it has been not inaptly termed the *villous* tumour, inasmuch as it mainly consists of elongated processes or villi, extremely vascular. This form of tumour produces most severe symptoms of a foreign body in the bowel, and is the cause of periodical hæmorrhage to a large extent, by which the health becomes very much broken down. It is a question with some as to whether this form of polypus is malignant or not.

Mr. Quain has made some investigations into the structure of this tumour, and he has found that it was composed of long processes slightly held together, each process strictly resembling villi. And as the mass is very vascular, he has concluded that the disease is not of a malignant nature, as stated by Rokitansky.

[1] It is very important to make a thorough examination of the rectum immediately after the bowels have been acted upon, when there is a suspicion of a polypus, otherwise the disease may escape notice. A remarkable illustration of this occurred in a lady to whom I was called by a medical practitioner, who had been in constant attendance upon the patient, whose symptoms were referred to some external piles. These were removed, but with scarcely any relief to the severe pain experienced after the action of the bowels, and to the sense of protrusion. I made a careful examination, after the bowels had been well cleared with an enema; but nothing was observable beyond a slight crack at the posterior part of the anus. It was thought right to divide this, in the hope that the severe pain would be removed by the operation, but this failed in its object; and we were vainly endeavouring to ascertain the cause of her suffering, until on one occasion we found the patient had just got into bed after having had the bowels freely acted upon. I took the opportunity of examining her immediately, and to my great surprise found a large fleshy polypus attached high up to the posterior wall of the gut by a narrow peduncle. Without further delay, I, with some difficulty, placed a double ligature around this tumour, and thus fortunately removed a disease which, from being long undetected, had caused great suffering. It was strange that this polypus had not shown itself when I examined her on a previous occasion after the action of the enema.

A very interesting specimen of this rare form of tumour of the rectum is preserved in the Museum of St. George's Hospital, and on examination it presents exactly the features described by Mr. Quain. It was situated about three inches from the verge of the anus, in the anterior wall of the rectum, evidently springing from the submucous cellular tissue. It is round in form, circumscribed and prominent, and about the size of an orange. The tufts or processes are remarkably well developed. The tumour so obstructed the cavity of the bowel, that almost complete retention of the fæces resulted, and the gut above was very much distended. The bladder was much pressed upon by the diseased mass. It was impossible to say how long the disease had been growing, but it was not detected until about five years before death, when the occurrence of hæmorrhage and of the symptoms before spoken of led to its discovery. Several attempts were made to destroy the mass by ligature and other means, but it was not possible to effect more than a partial removal of the more prominent portions—an operation which was performed no less than thirty-three times before his death, and on each occasion with temporary benefit. The patient was 70 when he died, and no other disease was found on a careful examination of the body.[1]

Fig. 177.—Villous Tumour of the Rectum. (From a preparation in the Museum of St. George's Hospital.)

I have only once met with an instance of a growth of this nature. but it was of a very nteresting character, inasmuch as it had resisted treatment and had reduced the patient to a very low state. It was that of a married lady, sent to me by Dr. Rooke of Cheltenham. She had suffered much from profuse hæmorrhage from the bowel without any protrusion whatever, and when I first saw her it was extremely difficult to ascertain where the bleeding came from, but after a very careful examination with the speculum, I found a well-defined vascular growth, about the size of a crown-piece, two inches from the anus. From the condition of the patient, and the appearance of the diseased parts, I was afraid that it might be of a malignant character, and this idea was somewhat confirmed by the continuance of the bleeding, notwithstanding very careful local and general treatment. However, finding milder measures fail, I determined to apply with vigour strong nitric acid to the part. This I did on several occasions, and was much pleased to find that the bleeding became checked, and after about half-a-dozen applications the hæmorrhage ceased, and the patient's health was rapidly restored. I saw this lady lately, some three years after the treatment, and she was in remarkably good health.

Pruritus Ani.

This affection is very common, and very productive of suffering; and, although, certain pathological changes occur at the margin of the anus in connection with it, itching and irritation of this part must be regarded rather as a symptom than as a special disorder. Thus it is frequently associated with an unhealthy state of the secretions of the intestinal canal, or with simple constipation—a fact which is not uncommonly overlooked in the treatment of those who suffer; it is also attendant upon a congested state of the vessels of the rectum, which can hardly be considered hæmorrhoidal, inasmuch as on examination there will be found neither hæmorrhoidal tumours nor prolapsus, but a considerable amount of congestion of the mucous membrane. This form of the complaint is peculiarly prone to occur in those who sit for a long time together at the desk. Pruritus is familiar to us as a symptom of ascarides in the rectum; it is also found in a very distressing degree in connection with disordered condition of the womb. I have recently seen a case of ulcer of the rectum, where the only well-marked symptom attending upon this usually painful morbid condition was a constant and troublesome itching.

Certain morbid changes occur around the margin of the anus in advanced cases of this disorder, in consequence of the attempts of the patients to relieve themselves

[1] *Path. Soc. Trans.* xii. 120.

by scratching and irritating the parts; the naturally thin skin becomes excoriated; the secretions of the part are exaggerated; and if the irritation is continued, fissures, and even ulcerations, are formed; and in course of time the integument becomes thickened and indurated, and gets almost into a condylomatous state; and a painful and distressing itching is produced—especially when the patient lies down in bed—which is most troublesome to remove.

In these cases there will be generally found some morbid alteration, in the form of slight ulcerations or fissures of the skin, and the first object is to heal these; and it may be effected by the very careful application of a solution of nitrate of silver—of a strength varying from ten to twenty grains of the salt to an ounce of water—by means of a camel's-hair brush. The application should be repeated so long as the cracks or ulcerations exist. Not unfrequently the itching and irritation will disappear as soon as these heal and the skin becomes healthy; but there is a tendency for the excoriations to reappear; and to prevent this, the patient should be advised to bathe the parts well morning and night with a strong solution of alum. If the solution of nitrate of silver fails either to heal the fissures or to give relief to the itching when they are healed, an ointment composed of one drachm of glycerine to an ounce of lard may be used with good effect; and should there exist a thickened or condylomatous condition of the integument, I know of nothing more useful than the application of an ointment composed of one drachm of calomel and one ounce of lard. If an ulcer—as in the case mentioned before by me—should be found to exist within or upon the sphincter, the ordinary operation for that malady must be put in force.

In some obstinate cases, it will be found that the use of all the usual measures, general and local, will be unattended with relief. If it has not already been tried, I am in the habit of recommending the daily introduction of a well-oiled bougie made of black wax.

Neuralgia of the Rectum.

It is perhaps impossible to affirm with truth that neuralgia, as it attacks other parts of the body, is ever situated in the rectum; but every now and then cases are met with where extreme suffering of a distinctly neuralgic character is experienced for a long period, and where, on the most careful examination of the parts, both external and internal, no appreciable lesion can be found; and we therefore do not hesitate to apply the term neuralgia to this condition of things. The cases are more frequently met with in the persons of females who have been lowered by some depressing causes; the pain is described as being very severe and continuous, and not particularly aggravated by the action of the bowels, as is the case when the suffering is produced by a painful ulcer of the rectum. It may be of a marked periodical character, and be the result of direct exposure to cold.

The cure of this affection is extremely difficult, and indeed sometimes only a temporary relief can be given. Of course, when a patient applies with the symptoms of neuralgia, the most careful examination of the parts should be instituted, and repeated from time to time; for doubtless in some of those cases which have been supposed to be neuralgia, there has been some lesion which has been overlooked. If, however, nothing of the kind can be met with, a similar treatment to that which is put in force for neuralgia in other parts should be adopted, due regard of course being had to the removal of any local irritant from the bowels in the shape of hardened fæces; iron and quinine in large doses should be exhibited, especially in those cases where there has been any lowering of the system; should there be any tendency to gout—a point not to be overlooked in our inquiries—colchicum should be prescribed. The local remedies best suited for this complaint are, the employment of the cold douche to the anus, and the use of belladonna ointment, in the proportions of one drachm of the extract to one ounce of lard, either smeared around the anus, or introduced up the rectum by means of a large wax bougie. Should the latter measure be adopted, care should be taken to watch the effects of the belladonna on the system.

Henry Smith.

GENERAL DISEASES OF THE SKIN.

THE classification of skin diseases which I shall adopt in this article is substantially that originally proposed by Plenck of Baden, and adopted with some modification by Willan, and subsequently employed by a large number of writers on the subject. At the same time I shall deviate from Willan's arrangement widely in one or two important particulars. The microscope, by revealing the presence of parasitic plants in certain of the diseases of the skin, and the close study of these same diseases, by which the relation between the plant and the disease has been ascertained, enable us to found a new order, and so, by abstracting certain diseases from some of the orders of Willan, to render those orders infinitely more natural.

The faults in principle of Willan's arrangement are many and obvious; but it is eminently practical. The diseases grouped together in his arrangement by no means agree pathologically; but his divisions greatly facilitate diagnosis; they enable the name of a particular case of disease to be learned, and this being learned, its pathological and anatomical position may subsequently be determined.

Order 1. *Exanthemata.*—The diseases of this group have, as their great characteristic, redness, disappearing or diminishing transiently on pressure. The cutaneous affection is essentially nothing more than an increased quantity of blood in the vessels of a portion of the skin. Now and then, however, the blood accumulates in such quantity at particular points as to cause a little elevation of the cutis; and if these points are small and circular, we have an appearance of papulæ; but the elevation, like the redness, disappears on pressure; to return, however, when the pressure is removed.

The connection between the hyperæmic cutis and the cuticle covering it is usually diminished either before or during the stage of resolution; and the consequence is, that there is generally a little desquamation of the cuticle while the rash is fading, or after the redness has disappeared. It is probable that the loosening of the cuticle is due to the effusion of a small quantity of serosity from the engorged vessels of the surface of the cutis. Now and then, indeed, fluid is effused in sufficient quantity to raise the cuticle from the cutis: thus in the eruption of scarlet-fever it is common to find innumerable vesicles stud the red surface; and in erysipelas the cuticle is occasionally elevated into bullæ. Besides certain eruptive fevers and erysipelas, the exanthemata include erythema, roseola, and urticaria.

Order 2. *Hæmorrhagia.*—In the exanthemata the blood is within the vessels of the red part; in the order hæmorrhagia the blood escapes from its vessels into the substance of the cutis, and so crimson spots unaffected by pressure are formed. There are only two diseases thus distinguished, viz. purpura and scurvy. But hæmorrhage into the substance of the cutis occurs not unfrequently in the course of all diseases of low type. If the hæmorrhagic spots be small, they are termed petechiæ; if large, vibices or ecchymoses. When small, the spots formed by cuticular hæmorrhage are usually circular; at the bend of the elbow, however, they are oval. When large, they are often very irregular in form.

Order 3. *Vesiculæ.*—These diseases are characterised by the development of vesicles, *i.e.* of minute collections of serous fluid seated immediately under the cuticle. Although at first transparent, this fluid ordinarily becomes in a short time opalescent, milky, or even puriform. The cuticle covering it is also at first quite transparent; after a while, however, it, like the fluid beneath, grows white and opaque. This

change in the cuticle may precede that in the contents of the vesicle. The fluid of a vesicle is formed on the surface of the cutis, directly beneath the cuticle. The fluid from a vesicle may be absorbed, or it may dry up and form with the cuticle over it a thin scale; this scale may be detached, or it may remain attached and be thickened by fresh secretion beneath it.

If the vesicles are very small and numerous, and the fluid in them contains but little solid matter, then a mere furfuraceous desquamation follows their bursting, or their desiccation; under these circumstances the vesicular nature of the disease may be overlooked, and the desquamation of the cuticle only noticed.

If the fluid contains a large amount of solid matters, or if the scales first formed be thickened by the drying on them of fresh secretion, then flat scabs of a yellowish-brown colour are formed. These scabs are often raised at the circumference. Dry or moist honey-like scabs are never formed by the drying-up of vesicles.

It has been said that vesicles are formed at the orifices of sudoriferous ducts; but, although this may be true in some cases, all vesicles are not so constituted. The vesicular diseases are: sudamina, miliaria, eczema, and herpes.

Order 4. *Bullæ.*—The diseases belonging to this order of skin diseases are distinguished by the eruption of blebs or bullæ; that is to say, collections of serosity of considerable size, situated directly beneath the cuticle, and raising the cuticle from the cutis. Bullæ differ from vesicles only in size. They vary in diameter for the most part from a quarter of an inch to two inches; but now and then attain the dimensions of half a hen's egg. The fluid of bullæ, like that of vesicles, as well as the cuticle over them, may be transparent or opalescent. Bullæ may be followed by crusts or by ulcers. Pemphigus and rupia are the only two diseases belonging to this order.

Order 5. *Pustulæ.*—The presence of pustules marks this order. Pustules contain pus from the moment of their formation. The inflammation, on which the formation of pus depends, extends some depth into the cutis; so that the collection of pus which constitutes the pustule is situated in the cutis and not merely on it immediately beneath the cuticle.

When vesicles become opalescent, their opalescence depends on the presence of pus-corpuscles and molecular matter; but true vesicles, whether their contents be transparent or milky, are never sunk into the cutis, and the pus-corpuscles when present constitute a very small proportion of their contents.

Pustules are followed by thick and dry or by honey-like crusts.

There are three forms of pustules—viz. psydracia, phlyzacia, and achores.

Psydracia are very little raised above the level of the cutis. They are seated in the hair-follicles—a hair passing through the centre of each pustule. The redness around this variety of pustule is frequently very trifling, especially when the pustules are placed at some distance from each other; when near together, however, the skin between may be red, hot, and swollen.

Phlyzacia are distinct pustules of some size, seated on elevated, inflamed bases. They are found especially on the trunk and extremities, and they terminate in small brown scabs.

Achores are very small pustules on comparatively large inflamed bases; base and collection of pus, however, form together only a small pustule. Achores are formed in considerable numbers in the vicinity of each other, the cutis between being red, hot, and swollen. They are more common on the face in children than elsewhere. The secretion from them forms those very large, thick, irregular-shaped scabs, resembling dried honey in consistence, so common on the chins of children. Achores are inflamed hair and sebaceous follicles.

Impetigo and ecthyma are comprised in the order pustulæ.

Order 6. *Papulæ.*—Papules are solid elevations of the cutis of small size, papilliform; their colour varies from dull white to bright red. When red, the colour may be removed for an instant by pressure, but the elevation remains. Papules are supposed by some to be enlarged papillæ; but the researches of Gustav Simon prove that papules may be formed at any point of the cutis by infiltration of the cutis at that point with serosity.

Three affections belong to the order papulæ, viz. strophulus, lichen and prurigo.

Order 7. *Squamæ.*—The order squamæ is characterised by the formation of an excessive quantity of epithelium-scales loosely attached to each other and to the cutis. By the slightest friction dry opaque white scales are detached from the diseased surface.

Psoriasis and pityriasis are the only affections which strictly belong to the order squamæ. Ichthyosis and xeroderma, however, may be conveniently retained, as Willan placed them, among squamous diseases.

Order 8. *Tubercula.*—Solid hard elevations of the cutis, much larger than papulæ, are called tubercula. In this order are included several diseases anatomically and pathologically very different from each other. The order tubercula includes molluscum, acne, lupus, leprosy, elephantiasis, frambœsia, and keloid.

Order 9. *Maculæ.*—The diseases of the order maculæ are characterised by the presence of too much or too little pigment in the parts of the skin affected, and therefore by white or dark-coloured spots. They are lentigo, ephelis, vitiligo, and nigrities.

Order 10. *Parasitæ.*—The diseases of the skin in which a vegetable parasite is invariably present are tinea tonsurans, tinea favosa, tinea sycosis, and chloasma. Tinea decalvans is also placed in this group.

There is only one disease characterised by the presence of an animal parasite, viz. scabies.

Order 1.—Exanthemata.

Roseola is an acute disease, of trifling importance so far as concerns the safety or the suffering of the patient.

Roseola is so named from its colour. It is characterised by small rose-coloured spots, or by a roseate mottling of the skin. The spots are slightly raised.

All varieties of roseola have a constitutional origin. There is one variety very common in children and young persons of both sexes (hence called by some r. infantilis), and especially prevalent in hot weather (and therefore named r. æstiva), in which rose-coloured spots and mottling give to the skin an appearance very closely resembling that of measles. From the rash of measles that of roseola æstiva differs in the absence of a crescentic form or arrangement of the spots—a character rarely wanting in measles; in the very irregular shape of the patches, and in their more rosy and generally paler hue; in commencing on the most prominent parts of the face and extremities, instead of, as in measles, about the edge of the hairy scalp; in its limitation not uncommonly to a small part of the trunk, or to a single limb; and in its irregular course.

Trifling febrile disturbance usually precedes the rash for a few hours, or it may be a day or two, and dryness and redness of the fauces are common. The coryza, so distinctive of measles, is never observed in roseola æstiva. A measles like rash, accompanied by sore-throat, and without coryza, should suggest the possibility of the case being roseola æstiva. If more than one child in the same family is affected, the probability is in favour of the disease being measles; but the writer has seen two sisters, after an error in diet, affected at the same time with well-marked roseola æstiva. Sometimes those of the greatest experience will be in doubt whether the case be one of roseola æstiva or of measles.

The duration of roseola æstiva is by no means constant. The rash may disappear in twenty-four hours, or it may remain out for four or five days. Occasionally it appears again after having once vanished.

A roseolous rash resembling this occasionally occurs as an epidemic. It is the disease to which the name bastard measles, German measles, or rötheln, has of late years been applied.

A rose-coloured rash, very similar to that of roseola æstiva, sometimes precedes the eruption of small-pox. It occurs especially at the flexures of the joints. The pain in the head and back, and the vomiting, which precede the eruption, indicate the nature of the case, as no such symptoms precede the rash in any other form of

roseola. Sometimes this variety of roseola bears a close resemblance to the rash of scarlet-fever.

A similar rash may accompany vaccinia, gout, and rheumatism; it may under these circumstances cover more or less of the trunk and extremities, or it may occur in patches. The specific name is derived from the constitutional disease to which the roseola is secondary, *e.g.* roseola variolosa, roseola vaccina, roseola rheumatica.

The remaining two varieties of roseola differ altogether in appearance from roseola æstiva. Now and then in adults, as well as children, and more commonly on the arms than elsewhere, a few rose-coloured circular spots are seen, varying in size from a threepenny-piece to a shilling. These spots are not elevated, or only very slightly so, and their colour disappears on pressure. As this affection has been thought to be more common in the autumn than at any other period of the year—though its especial prevalence at that time of year is doubtful—it has been called roseola autumnalis. It is a disease of no importance, and may not be accompanied by any general or internal local derangement, though occasionally there is a little febrile disturbance, or some dyspepsia. It rarely lasts more than a week or ten days. On the lower extremities, and sometimes on other parts, we observe several rose-coloured rings, varying in diameter from a quarter of an inch to an inch. The colour of the skin within the rings is quite natural. The rose-red colour is the only deviation of the skin from its healthy state. This form of roseola is named roseola annulata. Like roseola autumnalis, it is usually accompanied by a little febrile disturbance, and runs its course in a few days. Now and then, however, it is a chronic disease, lasting for many weeks.

Treatment.—A warm bath or two, rest, simple diet, and a single dose of mercurial at bedtime, followed by a mild saline aperient the following morning, are usually all that is required in the treatment of a case of roseola. Roseola infantalis is sometimes the consequence of painful dentition; should the gums be hot and swollen, they ought to be scarified. In the chronic form of roseola annulata, the digestive organs are commonly much deranged, and the patient more or less generally out of health. Change of air, mild tonics, such as the mineral acids, and sea-bathing, are the best remedies. At the same time care must be taken to regulate the patient's diet. As the dyspepsia is of the atonic form, a glass or two of wine daily is usually of advantage. As this disease is sometimes dependent on uterine disturbance, the condition of the uterine and vaginal discharges should be ascertained.

The eruptions proper to typhus fever, measles, German measles, typhoid fever, scarlet fever, and cholera are in reality roseola, but differ in important particulars from the varieties just described. The rash of typhus and of measles as much merits the name of roseola as does that which precedes the eruption of small-pox. The mulberry rash of typhus fever differs from the other varieties of roseola by its dusky colour and the petechial character assumed by the separate spots as the disease progresses; the exanthem of typhoid fever by the wide separation of its constituent spots from each other, and their papular form; that of measles by the crescentic arrangement of its spots; the rash of scarlet-fever by its punctiform character, its colour, and the extent of surface covered; that of cholera by the size and irregular form of its spots and their tint. All are distinguished by their course, and by the constitutional disturbance which precedes and accompanies them.

Erythema is characterised by patches of redness of irregular form, and of rather large size, often somewhat raised above the level of the adjacent skin. When at its height the colour of the patch is vivid red; before disappearing the patch assumes a bluish hue. Pathologically considered, there are two distinct kinds of erythema, one having a local, the other a constitutional origin.

Varieties of erythema of local origin.—When two folds of the skin overlap each other, the secretions accumulate, and the two surfaces chafe each other; inflammation of the skin is the consequence—intertrigo, or erythema intertrigo, as it is called—a disease very common in the groins and necks of young children and fat women. A little moisture exudes from the inflamed surface.

The inflammation of the skin resulting from a burn is one variety of erythema. That peculiar inflammation of the skin which we call a chilblain is, when dignified by a scientific name, erythema pernio. When the skin stretched over an œdematous part inflames, as often happens, the disease is erythema læve. If the patient lies long on one spot, and the skin over it inflames, it is erythema.

Chronic local erythema is pretty common on the face, around the lips, and on the buttocks of young children. The skin, when inflamed about the lips, the orifice of the vagina, the prepuce, the groins, and the anus, is peculiarly liable to crack.

Treatment.—Intertrigo is best treated by frequent ablution, bathing the inflamed surface with an astringent wash—a solution of acetate of lead is one of the best—and then, after carefully drying the part, dusting it with an absorbent powder, such as starch or oxide of zinc. It is important to bear in mind, with reference to erythema læve, that the inflammation of the skin increases the œdema of the subcutaneous tissue. If, as is usually the case, it is the lower extremities which are the seat of erythema læve, they should be raised, to favour not only the return of blood from the limbs, but also the draining of the serosity out of the tissue. A few punctures in the thigh with a fine needle, by permitting the escape of serosity from the cellular tissue, will aid the cure of the erythema. If the œdema be not reduced, bullæ sometimes form on the erythematous surface, and finally the skin ulcerates or even sloughs. As to the erythema from pressure, that is best treated by careful drying of the part after washing, the application several times a day of spirit of wine, or an astringent solution, as alum; but, above all, by extreme attention to cleanliness and frequent change of position. A sore back from pressure rarely occurs in fever or paraplegia, the diseases in which it is most common, if the patient be well nursed.

Varieties of erythema of constitutional origin: e. fugax, e. papulatum, e. nodosum, e. circinatum (syn. *annulatum*), *e. tuberculatum, e. marginatum.*—The local disease in these varieties of erythema, although characterised by redness, &c., hardly merits the name of inflammation, unless we give to that vague word a very wide signification. All these varieties of erythema are more common in those disposed to rheumatism.

Erythema fugax is distinguished by the sudden appearance of large red patches, and their equally sudden disappearance after a time varying from a few minutes to a few hours. The patches of erythema fugax are more common on the face than elsewhere; not infrequent on the trunk; rather rare on the extremities. The usual cause of erythema fugax is some article of diet. The patches disappear in less than half-an-hour. That erythema fugax results in some cases from nervous influence is rendered probable by such facts as this: a gentleman, known to the writer, cannot even think of eating condiments without experiencing a sensation of heat in the face, forehead, and scalp, conjoined with some redness of the part.

Erythema nodosum is a common affection in girls from six to twelve years of age, and not very rare in delicate boys and adult females, characterised by the eruption of distinctly elevated red patches of an oval, or more rarely circular, form. The oval patches are from one to two inches in length, the circular from half an inch to an inch in diameter. Each patch lasts from four to ten days; fresh patches appearing every day or two. The disease is commonly finished in a fortnight or three weeks. In persons past the middle of life it occasionally lasts for months.

On their first appearance, the colour of the patches is tolerably bright red; but when about to fade, the patches assume a bluish or violet tint. Exposure to cold also gives to the erythematous patch the same hue. This bluish colour is very characteristic of erythema. Over the anterior aspect of the tibia, which is the ordinary seat of erythema nodosum, the patches are commonly oval, their long axis being from above downwards; about the knee-joint, and at the back of the leg, they are usually circular. On the upper extremity, where they appear in rare cases only, they are also circular. They are rarely seen on the lower extremities much above the knee, or on the upper extremities above the elbow. It is very rare for patches to occur on the trunk.

Occasionally, several patches are evolved in the vicinity of each other; and their margins coalescing, a broad red patch is formed, here and there hard, elevated, and very tender, and presenting some resemblance to erysipelas. The redness of erysipelas, however, terminates by a well-defined line; whilst in erythema it shades off into the hue of the adjacent skin. The margin of an erysipelatous patch is as much raised as its centre; the elevation of a patch of erythema nodosum ceases by degrees with the redness. When the finger is passed over a patch of erythema nodosum, it feels as though the hardness were caused by something buried under as well as in the skin. Erysipelatous hardness is brawny in character and superficial. When several patches of erythema nodosum are present, the disease can hardly be confounded with erysipelas. The largest patches of erythema nodosum now and then convey to the finger a sensation of fluctuation; but they never suppurate, and the sensation of fluctuation is probably due to the presence of serosity in the subcutaneous cellular tissue.

Erythema tuberculatum and *papulatum.*—When patches, agreeing in other points with those just described as characteristic of erythema nodosum, do not exceed a four-penny-piece in size, the disease is called erythema tuberculatum; when not larger than a very small split-pea, the disease is called erythema papulatum. Sometimes circumscribed patches of a bright red colour, studded with deeper-coloured points, which to the eye resemble papulæ, but are without the elevation and hardness of true papulæ, appear on the arms, neck, and breast; the colour and slight elevation are both temporarily removable by the pressure of the finger. To these patches also the term erythema papulatum has been applied.

Erythema circinatum is not a very common disease. It affects children and adults, and ordinarily supervenes in the course of an attack of acute rheumatism. Its usual seat is the trunk.

The patches are ring-shaped. Sometimes, however, the rings are imperfect; and not unfrequently several rings coalesce at their margins. The rings are red, distinctly raised, terminate abruptly externally, as regards both colour and elevation, but shade off gradually towards the centre. Within the ring the skin has a faintly yellowish tint. The breadth of the red ring is about one-third of an inch. The patches are quite smooth; there is not a trace of scales, vesicles, or scabs on their surfaces. The colour of the rings of roseola annulata is darker than that of erythema circinatum, the elevation is scarcely perceptible, the outer margin is not abrupt, and the centre is the colour of the natural skin, instead of yellowish. Erythema circinatum, when acute, runs its course in about a fortnight or three weeks. There is a chronic variety, however, in which the rings are incomplete, and to it the name of erythema marginatum has been applied. Willan mentions that it occurs on the extremities and loins of aged persons suffering from internal disorders, and that its occurrence is an unfavourable sign.

Hebra considers e. tuberculatum, papulatum, circinatum, and a species from its form called gyratum, to be merely stages of the same species, and for this species proposes the term erythema multiforme.

A little desquamation of the cuticle covering the red patches follows the disappearance of all the varieties of erythema and roseola. The eruption of roseola itches slightly; that of erythema usually itches, burns, or tingles in a trifling degree.

It is evident that there is little or no essential difference between roseola and erythema; and that, excluding inflammation of the skin, dependent altogether on local causes, that variety of roseola which so closely resembles measles and erythema nodosum, the other varieties of roseola and erythema might well be grouped together into one genus, and this whether regard be had to their local or general pathology, or to their treatment.

Treatment.—A few warm baths, rest, mild aperients, simple salines, and a light diet, so long as the skin is hot, the pulse quick, and the tongue white; attention to the digestive organs, mineral acids, and vegetable tonics, after the febrile disturbance has ceased—these are the remedies for all. Erythema nodosum, tuberculatum, and

papulatum, and the chronic variety of erythema circinatum, usually occur in delicate persons; and in their treatment quinine is said to be particularly useful. Dr. A. Todd Thompson, whose remarks on treatment are always worthy of attention, found bark in many cases much more beneficial than quinine. In women past middle life, the eruption of erythema nodosum is thought to be connected with the cessation of the menstrual discharge. Erythema circinatum occurring in the course of acute rheumatism disappears spontaneously.

Urticaria.—The pathology and ætiology of urticaria, or nettle-rash, are so closely related to erythema fugax, and the two so often occur in the same individual, that we pass naturally from the genus erythema to urticaria. Yet urticaria is not correctly placed among the exanthemata. In urticaria there is something more than redness disappearing or fading on pressure; there are wheals, or pomphi, as they have been called.

Wheals are flat elevated patches of the skin. The sting of a nettle, the bite of a bug, the stroke of a whip, are each followed by a wheal. Wheals differ much in form, size, and colour. In form they may be circular, oval, or irregular; in size, they vary from two lines to some inches in length; in colour, from almost white to deep purple.

In urticaria each wheal is seated on a red patch; sometimes the patch is very large, the wheals small; sometimes the redness forms merely a narrow halo around the wheal; several wheals may be seated on the same red patch. Wheals frequently appear and disappear again with singular rapidity. Now and then the red patches remain for a while after the wheals have vanished; in some cases the red patch precedes the eruption of the wheal, in others the wheal comes out first; while in others, again, they appear simultaneously. When the red patch only is present, the disease may be very readily confounded with erythema; a little friction of the part, however, will prevent the mistake by bringing out the wheal. Now and then the surface covered by the redness is very considerable in extent, and then the wheals not being present, the case might possibly be taken for scarlatina. There may usually be detected on the red parts one or two wheals imperfectly evolved, which will reveal the true nature of the case.

Patients often mistake the pale elevations of the cutis for blebs, and say that large blisters occasionally come out over them. The wheals in urticaria itch, tingle, and burn. These sensations are often almost intolerable. Usually they are aggravated at night when the patient is warm in bed, when seated by a fire, and by the use of stimulating articles of diet. Now and then, however, the wheals and the itching, tingling, and burning sensations are only present when the patient is exposed to cold. Any change of temperature suffices in some cases to determine the evolution of the wheals. The structure of the wheals in urticaria has not been very clearly made out. The redness is, of course, caused by repletion of the vessels of the cutis; but to what is the elevation and pallor of the wheals due? Gustav Simon says that if a needle be passed into the cutis constituting a pale wheal, a little clear serosity only escapes; and he concludes from this that the swelling is occasioned by the presence of serosity in the substance of the cutis. The pallor is attributed to the quantity of serosity effused being out of proportion to the number of vessels loaded with blood. The sudden appearance and disappearance of the wheals seem, however, to be opposed to these ideas.

Urticaria is a very common disease. It occurs at all ages. Persons prone to rheumatism are especially liable to urticaria.

Varieties of urticaria.—Local urticaria results from the application to the skin of certain irritants, *e.g.* a blow, a sting, &c.

A most acute and severe form of urticaria is not unfrequently the result of a single error in diet. In some persons shell-fish, in others pork, in others pastry, in others the more common articles of diet, as eggs or sugar, produce an attack of urticaria, and this although the food be the best of its kind. In some persons an attack of urticaria only occasionally follows the use of particular substances; in

others it is the invariable consequence. The patient is said to be poisoned by what he has taken. An attack of urticaria having such an origin usually terminates in two or three days. The eruption may appear very rapidly after the ingestion of the noxious substance. It not unfrequently occurs within an hour. The eruption may disappear in a few hours. As a rule, the sooner after the ingestion of the noxious agent the symptoms appear, the more quickly do they disappear. Mr. B. Squire has seen cases of acute urticaria due altogether to the presence of the *acarus scabiei* in the epidermis.

An acute attack of urticaria sometimes occurs without the patient having committed any error in diet. It is then generally preceded for a day or two by some febrile disturbance. There are no special symptoms present in these cases to indicate that the pyrexia is only the prelude of an attack of nettle-rash. The eruption of the wheals is the first intimation of the exact nature of the disease. This variety of urticaria ordinarily lasts a week. It is termed u. febrilis.

More frequently urticaria is a chronic disease, and it may then last for years. Sometimes the wheals are confluent, or almost so, and then the disease is called urticaria conferta. Occasionally, even in comparatively chronic cases, the wheals that first appear remain out till the patient is permanently well. Urticaria, in which the wheals are thus permanent, is called urticaria perstans. Far more commonly the wheals come out in crops, so to say, which last only a few hours, fresh crops appearing with every change of temperature, with every abnormity of diet, or on the slightest friction. Now and then not a wheal appears for a week or two, and then a fresh crop comes out. Urticaria, characterised by these evanescent wheals, is urticaria evanida. In rare cases the wheals attain a very large size, and then the disease is urticaria tuberosa; in still rarer cases the patient suffers from the burning, itching, and tingling sensations in numerous parts where no wheals appear, and then Willan called the disease urticaria subcutanea.

In regard of the species of urticaria, all the important points may be summed up thus: the disease is now and then a very acute disease, distinctly referable to an error in diet; now and then an acute disease not referable to error in diet; more often the disease is chronic, the wheals appearing and disappearing rapidly on the slightest cause, or even without any known cause.

Treatment.—When acute urticaria arises from the patient having eaten some substance which he has imperfectly digested, an emetic, followed by a mercurial and saline aperient, is generally all that is necessary for the cure. If there be much depression at the outset, it may be necessary to give a little ammonia; or, on the other hand, if the febrile disturbance be great, to take a little blood from the arm.

In the treatment of the chronic forms of urticaria especial attention is to be paid to the patient's diet. In some cases abstinence from coffee, in some from tea, in some from milk, in some from porter, in others from the water they were drinking, has been followed by recovery. I know a young lady who always suffers from urticaria when she resides in a particular locality, from the quality, it seems to me, either of the air or of the water at that spot; and she informs me that many persons in the same village suffer from the disease. While residing there, medicine has little effect on the disease; when she leaves that village, no medicine is required for her cure.

After regulating the diet, a mild course of antacid saline aperients is often useful. In other cases, saline aperients, combined with a bitter infusion and a mineral acid, seem to be the most efficacious remedies.

A course of cold sea-baths is sometimes followed by recovery when other means have failed. If the patient is plethoric, and the pulse is full and hard, a single blood-letting, to a moderate extent, affords much relief. In obstinate cases, arsenic in small doses—as three minims of liquor arsenicalis three times a day—continued for some time, has effected a cure. Some physicians attach much importance in the treatment of urticaria to quinine, in doses of two or three grains three times a day. Colchicum is with others a favourite remedy. Carbonate of potash or liquor potassæ, with a bitter infusion, three times a day, is sometimes useful, by correcting deranged conditions of the stomach.

The disease may often be kept in abeyance, the eruption of fresh wheals be prevented, and the irritation of those present be allayed, by sponging the whole surface night and morning with lemon-juice or vinegar. Sir E. Wilson speaks very highly, for the latter purpose, of a lotion composed of bichloride of mercury, from five to ten grains, spirits of rosemary and spirits of wine of each one ounce, and six ounces of the emulsion of bitter almonds.

If a child suffering from urticaria be cutting its teeth, and the gums are hot, dry, and tender, they should be lanced. A single dose of calomel and jalap usually suffices to cure the disease in the young child.

Order 2.—Hæmorrhagia.

Purpura is characterised by an eruption of spots (petechiæ) or patches (vibices or ecchymoses), both due to hæmorrhage into the derma, varying in tint from bright red to violet. In diameter they are less than a line to more than an inch; the smallest spots are round, the larger more irregular in shape. At first the spots have an abrupt well-defined margin; but after a time their outline is gradually lost in the surrounding skin. Their distinguishing character is that they do not disappear or fade under pressure, in this respect differing from all forms of eruption with which they could be confounded. In a few days they begin to fade and slowly disappear, becoming orange-coloured and yellowish. New spots appear as old ones die away.

Purpura has been subdivided into p. simplex and p. hæmorrhagica. The latter is only a severer form of the former, in which hæmorrhage takes place not only into the skin but from the mucous membranes of the nose, alimentary canal, urinary passages, and other parts. Willan described a variety, under the name of p. urticans, in which there is a reddish elevation of the skin resembling a wheal, which subsides in a few days, and leaves a livid spot on the level of the skin. Purpura is not accompanied with tingling or itching.

In mild cases of purpura there is little or no disturbance of the general health. In severer cases, the eruption is often preceded by febrile symptoms, lassitude, and pains in the limbs. In some cases, however, without any previous constitutional disturbance, profuse hæmorrhage may occur both into the skin and from the mucous membranes.

Scorbutus is quite a distinct disease from purpura, though, like it, accompanied by cutaneous hæmorrhage. The gums are not spongy in purpura, nor is there usually the yellow sallow hue which is met with in scurvy. Some of the acute specific diseases are occasionally accompanied with petechiæ, and typhus is specially called the petechial fever from the ordinary characters of its eruption. Other symptoms will enable the practitioner easily to distinguish these eruptions from purpura. Neither the pathology nor the ætiology of purpura is understood. It is not dependent on a want of fibrin in the blood, nor is it caused by the want of fresh vegetables, or even by poor living.

Treatment.—Astringents, such as gallic acid and acetate of lead, are occasionally of use. The tincture of the sesquichloride of iron and mineral acids have been useful in other cases. Turpentine and creasote have been much extolled by some writers. Dr. Williams thinks that purpura is often connected with hepatic congestion and imperfect secretion of bile, and is best treated by remedies which tend to relieve this state.

T. H.

Order 3.—Vesiculæ.

Sudamina.—The vesicles to which this term is applied resemble minute drops of perspiration. They are colourless and very transparent. There is no redness around them. Sometimes they are so small that they are more easily detected by the finger than by the eye. In two or three days the vesicles either burst, or the fluid in them disappears, and there is a little furfuraceous desquamation of the cuticle at the parts where they were situated. The contents of a sudamen never become opalescent.

Sudamina appear in the course of certain acute and chronic affections, and are especially common in typhoid fever, during the third week of the disease. A single crop of sudamina never lasts more than two or three days. I think, in common with others, that these vesicles are seated at the orifices of the sweat-ducts, and that they are connected with the occurrence of perspiration. They may cover the whole anterior and lateral regions of the trunk; but more commonly they occupy those parts to which perspiration is often limited, *e.g.* the base of the neck, the sides of the thorax, the epigastrium, and the groins.

The contents of the vesicles are almost always acid. Sudamina rarely occur after the middle period of life. They are of no value as a guide for prognosis; and as to treatment, they themselves require none. A crop of sudamina indicates that the patient has perspired, and should lead to inquiries into the ventilation and temperature of the room, the condition of the linen of the patient, &c.

Miliaria.—Miliary vesicles are acuminated with a red halo around their bases. Their contents quickly lose their transparency, and become almost or quite purulent in appearance. Miliary vesicles occur, like sudamina, in the course of other affections. They are often seen on the trunk and extremities in acute rheumatism. They differ from sudamina in being acuminated, in the opacity of their contents soon after their eruption, and in the redness of the skin around.

Like sudamina, they appear to be connected with the occurrence of perspiration. During the summer months it is very common to see the trunk of children, and even of adults, who perspire freely from exercise or other cause, and especially if they are not frequently washed, covered with a crop of minute miliary vesicles. In these cases the redness around each vesicle is sometimes much more readily seen than the vesicles themselves, and then the disease may be mistaken for roseola æstiva. Not unfrequently roseola æstiva is complicated with the eruption of a few miliary vesicles.

Frequent ablution and a gentle purge are all that is required in the treatment of the miliary vesicular eruption of children. There is an epidemic febrile disease of from eight to ten days' duration, characterised by profuse sweating and a miliary eruption. It has been called miliary fever; some cases of it are detailed in Rayer's work on skin diseases. Some persons under the term miliary vesicles include sudamina and miliary vesicles proper.

Eczema is a very common disease, and occurs at all ages. It is characterised by the eruption of small vesicles on imperfectly defined patches of skin of some extent. The vesicles are usually pretty thickly set. Each vesicle is surrounded by more or less inflammatory redness. Sometimes the redness around the vesicles is scarcely perceptible, sometimes the whole skin between them is uniformly red, hot, and swollen; in the latter case, however, detached vesicles are always to be found at the margins of the patches, each having its areola of redness. When the vesicles burst, thin scales or scabs cover the surface of the patches. These scales or scabs are composed of epithelium, and the fixed constituents of the fluid of the vesicles. When the fluid in the vesicles contains but little animal matter, the scales are thin, white, and opaque, and the disease may be mistaken for one of those belonging to the order squamæ.

When the fluid of the vesicles contains much animal matter, the scabs are brownish or yellowish in hue. But the scabs formed from the drying up of a crop of the vesicles of uncomplicated eczema are never thick. The disease may disappear with the drying up of the first crop of vesicles; but this is by no means constantly the case. Two, three, or more crops of vesicles may follow each other in quick succession; and the surface on which they are seated may be red and raw in appearance, and a clear serous fluid, strongly alkaline in reaction, ooze from it in considerable quantity. This fluid excites inflammation of the surface over which it flows. It scalds, as it is said. Instead of being raw in appearance, it may be that the surface is hot, red, and swollen; and just under the cuticle are perfectly flat irregularly-shaped collections of serosity, or of somewhat purulent-looking fluid. The appear-

ance is as if turbid serosity or thin pus were burrowing in all directions just under the epidermis. The fluid in this, as in other forms of eczema, is alkaline. Scabs of large extent, but still thin, are formed by the drying up of this subcuticular fluid.

Where the cuticle is rather thick, and the vesicles are very small, the surface may seem to be red and rough only, with cracks here and there, from which a more or less alkaline serosity oozes in small quantity. The surface thus affected is often of considerable extent. It is a common form of eczema on the anterior aspect of the leg in persons past the middle period of life. The urine of those who suffer from it often contains a large quantity of the crystals of oxalate of lime.

Vesicles are not, according to Hebra, constantly present in eczema, and he therefore defines eczema as follows : ' A disease of usually chronic course, characterised by the formation of aggregated papules (e. papulosum) and vesicles (e. vesiculosum) or by more or less deeply red patches covered with thin scales (e. squamosum), or in other cases by a moist surface (e. rubrum) ; while in any of these forms there may be developed in addition, partly yellow and gummy, partly green or brown crusts (e. impetiginosum). The affection is constantly accompanied by violent itching which leads to excoriations, and it is not contagious.' ' I do not consider the formation of vesicles, and subsequently of a moist surface, as sufficient to characterise the disease ; but take in as varieties of the same malady all the morbid changes seen in the course of development and retrogression of the ordinary vesicular and moist eczema.'

The eczema papulosum is, Hebra states, the lichen eczematoides, and eczema squamosum the pityriasis rubra of some writers.[1]

Varieties of eczema.—As to the nominal varieties of eczema, the disease is called eczema vulgare or simplex, when the vesicles are distinct from each other, though pretty closely crowded, last a few days only, and then dry up and form furfuraceous scales. The inflammation of the cutis in e. simplex is never very severe, and may be trifling. E. simplex may be excited by any direct irritant of the skin ; as, for example, a stimulating liniment, exposure to the direct rays of the sun or of a strong fire, sugar, sulphur.

Eczema rubrum is distinguished from e. simplex by the degree of inflammation that accompanies the eruption ; the cutis between the vesicles is uniformly inflamed ; eczema simplex may therefore pass into eczema rubrum. In eczema rubrum the cutaneous and subcutaneous tissues are often considerably swollen ; the swelling is for the most part due to the effusion of serosity.

There are two diseased states of the skin called by the common name of eczema impetiginodes. In one, the inflammation is very severe, and the secretion is here and there purulent ; in the other, eczema is complicated with impetigo, *i.e.* with suppurative inflammation of the hair-follicles.

Hebra has described a variety of eczema which he terms eczema marginatum. It is almost limited to males, and especially observed in shoemakers. Its most constant point of origin is on the inner part of the thigh, with which the scrotum comes most in contact, and thence it may spread upwards to the abdomen, leaving untouched the penis and scrotum. Subsequently the disease may appear on other parts, *e.g.* breast, back, neck, extremities.

This variety of eczema begins, Hebra states, as a red, raised circular patch of the size of a sixpence ; it spreads at the periphery and there occur in succession papules, vesicles, excoriations, and afterwards small brown or black scales. As the circumference spreads, the centre heals, but retains a dark colour. Subsequently similar patches may appear in other regions. Although Hebra denies the syphilitic nature of this form of eczema, other writers are disposed to question his conclusion.

The face, the hairy scalp, and the skin behind the ears are all common seats of eczema ; but there is no part of the trunk or extremities which it may not, nay does not, frequently affect.

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[1] *Sydenham Society's Trans.* Hebra, ' On Diseases of the Skin,' vol. ii. pp. 85, 86.

Before and during the period of the first dentition, eczema is by far the most common of the diseases of the scalp. If a single crop of vesicles only appears, the disease will run its course in a week or ten days; but if crop after crop of vesicles follows each other, or if the surface is highly inflamed and 'weeps,' the disease may continue for a considerable length of time. When very obstinate, lasting for years, it has been called eczema inveteratum. Strumous children, from five to twelve years of age, are very liable to eczema of an obstinate character at the flexures of the elbow and knee-joints. An acute attack of eczema is sometimes preceded for a day or two by tolerably severe febrile disturbance. There is nothing characteristic, however, in the febrile symptoms; but the patient who has had one attack, being very liable to others, may suspect its nature. Sometimes, too, he feels before the eruption appears a peculiar heat and tingling of the part about to be the seat of eruption.

Parts affected with eczema burn, tingle, and itch. Some varieties of eczema are attended with intolerable itching; for example, eczema of the anus, labia pudendi, and scrotum, especially in old men, whose urine dribbling away irritates that part. Eczema is not contagious.

In children, as a rule, eczema is secondary to some constitutional state. In adult age it is more commonly due to direct irritation, as about the vulva in saccharine diabetes. In females it now and then appears in connection with derangement of the catamenial function, without known local exciting cause. Eczema of the lower extremities is sometimes secondary to a varicose condition of the veins.

Treatment.—The treatment of an acute attack of eczema must be influenced by the severity of the local affection, the presence of febrile disturbance, and the age and strength of the patient.

If the disease be acute, the local affection extensive, and accompanied by a good deal of heat, redness, and swelling, and the patient in the prime of life and robust, the best treatment is to take a moderate quantity of blood from the arm, to give a brisk calomel-and-colocynth purge, to follow this by a saline, antacid aperient, and to bathe the part itself with tepid goulard water. After the bowels have been freely acted on, small doses of antimony may be given every three or four hours. The diet in such cases should be low. If the patient be less robust, then the blood-letting must be omitted, and the purging and other treatment less active.

If the disease be chronic, and the inflammation moderate in degree, a bitter acid aperient, such as sulphate of magnesia one drachm, dilute sulphuric acid 10 drops, infusion of gentian $1\frac{1}{2}$ ounce, two or three times a day, is often very useful. Young children require occasionally a calomel-and-jalap aperient at bedtime. In the chronic forms care must be taken to ascertain that the patient is committing no error in diet. It is only in the aged or the delicate that stimulants, as wine or beer, are admissible. Slightly astringent local applications, as zinc ointment, are the best for mild cases. If the disease is very chronic, and there is little heat of the part, stronger local means are required, such as an ointment composed of half a drachm of the hypochloride of sulphur to one ounce of simple cerate, or a scruple of iodide of sulphur to half an ounce of simple cerate. In the strumous variety above mentioned as so common at the bends of the elbows and knees, and in that in which the cuticle is rough and cracked, and there is serous fluid oozing from the surface, a piece of linen soaked in a solution of nitrate of silver, a scruple to an ounce of water, may be applied twice a day. When, in the last-mentioned form, the urine contains a large quantity of oxalate-of-lime crystals, the nitro-muriatic acid, with decoction of bark and a good diet, should be prescribed. In strumous children, cod-liver oil and a good diet are essential to the cure. When young children suffer from eczema of the scalp, and the gums are hot, dry, and swollen, they must be lanced. If the disease continue, and the inflammation do not involve the cellular tissue, I have seen the disease rapidly yield to the plan of treatment recommended by Hebra:—The hair being cut off by a fine pair of scissors, and the scabs removed by linseed-meal or bread-and-water poultices, linseed-oil is to be applied at bedtime to the whole scalp, and the following morning the part is to be covered with liquid pitch; a single application is sometimes sufficient for the cure; when the pitch peels off, the scalp is found free

from eruption or inflammation. Care must be taken not to employ so stimulating an application as liquid pitch when there is much heat and swelling of the part. A child in the Hospital for Sick Children was nearly killed under such circumstances by the inflammation set up by the pitch; the inflammation extended from the scalp down the neck, and even below the clavicles, and abscesses of some size formed in the cellular tissue of the inflamed parts. However, when the child recovered from the terrible disease excited by the pitch, it was free from the eczema, and its cure was permanent, notwithstanding that it had been suffering from the affection of the scalp for two years previously. In very obstinate cases, in children as well as adults, arsenic administered internally exerts a decidedly favourable influence; three or four minims of the liquor arsenicalis in a little water twice a day to an adult, and a single minim to a child.

Parts affected with eczema should be washed frequently. Strong soaps should not be employed. Some physicians recommend the patient to use a little bran-water only; others employ egg instead of soap for washing the part. It is desirable to prevent the secretion from the inflamed surface running over the adjacent healthy skin; therefore the part should very frequently be wiped gently with a piece of soft lint. Dr. H. Bennet speaks in very high terms of the advantage he has seen follow from keeping the part constantly wet with a solution of subcarbonate of soda, two drachms to a pint and half of water. To prevent the lint drying, it is necessary to cover it with oil-silk or gutta-percha. The constant application of cold water is strongly recommended by Hebra; over the water a caoutchouc bag containing ice may be applied. He also after removing crusts employs various caustic applications, especially caustic potash, in form of solution or of soap.

The treatment of eczema may be thus summed up. If the local affection be manifestly inflammatory, it must first be treated altogether independently of the special eruption. When the active inflammatory stage has passed by, stimulating astringents must be applied locally, and the constitutional derangements treated as though there was no local affection; and lastly, these means failing, those remedies must be employed which may be denominated empirical. Always bearing in mind the importance of a diet regulated according to the age and general powers of the patient, and the necessity for local cleanliness.

Herpes is, like eczema, a non-contagious vesicular disease very common at all ages. It differs from eczema, however, in several particulars. The vesicles are arranged in groups on small, or at least not very large, pretty well-defined and somewhat elevated red patches. The vesicles of eczema are always small; those of herpes usually of some size.

The fluid of the vesicles is at first quite transparent, but it soon grows opalescent or puriform, and after a short time the fluid and the epidermic covering of the vesicles concrete into thin pale brownish scabs. When quite transparent, the fluid of the vesicles is slightly alkaline or neutral to test-paper; when opalescent, neutral or acid. The fluid of the vesicles in herpes never has the strongly alkaline reaction so remarkable in the transparent fluid that ‘ weeps ’ from the red surface of a patch of eczema.

Varieties of herpes.—The red slightly elevated patch that so often forms on the lip during that little feverish attack commonly called a cold, and which is shortly after covered by a crop of vesicles, is h. labialis. In a day or two the vesicles are replaced by a thin brownish scab; in two or three days more the scab falls off and a red stain only remains. When such an eruption occurs on the prepuce, as it often does, it is herpes præputialis. Patches identical with these, except that they are broader, and that the vesicles on them are larger, may appear on any part of the body, constituting herpes phlyctænodes. The cheek is a common seat of herpes phlyctænodes. Several patches often appear in the vicinity of each other. The disease ceases, as a rule, in less than a fortnight. Sometimes a week suffices for it to run its course.

Herpes zoster, *zona*, or *shingles*, as it is vulgarly called, is distinguished from the other varieties of herpes by the number and position of the patches of vesicles.

Several patches, distinctly separated from each other, appear at the same time or in succession. These patches are usually oval, and arranged on a line passing somewhat obliquely downwards and forwards from the spine to the middle line, in front. Most commonly they are seated on the thorax, next on the abdomen, and rarely on the face and neck. The patient is usually poorly for two or three days before the vesicular patches show themselves; sometimes considerable febrile disturbance precedes the eruption, and occasionally the patient suffers severe burning pain in the part where the eruption is about to appear, and even deep-seated pain in the chest when the thoracic parietes are to be its seat. H. zoster rarely occurs on the two sides of the body, and still more rarely is it symmetrical.

At first the contents of the vesicles are transparent, then turbid, and then thin brownish scabs follow. The disease runs its course in ten days or a fortnight. In rare cases, and only in adults, after the scabs fall off, the part on which they were seated is the seat of very severe and long-continued neuralgic pain.

Herpes zoster affects young children more frequently than it does adults. No age, however, is exempt. It rarely occurs twice in the same individual. In children and young adults it is a disease, medically speaking, of little moment.

As to the pathology of herpes zoster, the eruption is secondary to a general febrile affection, and the seat of the eruption is determined by the distribution of particular nerves, and most commonly of the dorsal nerves. The pain that precedes the redness, the limitation of the disease to one-half the body, the frequency with which it follows the course of some of the nerves on the thorax and abdomen, and even the fact that in some cases the upper arm has formed, so to say, part of the semicircle—all point to this conclusion. In reference to these last facts it may be observed that the lower intercostal nerves supply cutaneous branches to the abdominal integument, and that the second dorsal nerve supplies a branch to the skin of the upper arm, viz. the intercosto-humeral. When on the face, it follows the distribution of the fifth nerve, usually one division only; I have seen many cases of two divisions affected. Mr. Hutchinson has observed iritis complicate herpes following the course of the ophthalmic division of the fifth nerve. Theoretical consideration led Von Barensprung to regard the primary lesion to be irritation of the ganglia on the posterior roots of the nerves; the disturbance of the contiguous sensory fibres producing the neuralgia. Subsequent anatomical examinations have to some degree confirmed this view of the exact pathology of herpes zoster.

Treatment.—A mild aperient and a simple saline only are needed. No local treatment is required; nay, local applications very often seem to do harm: troublesome ulcers often follow the application of the most simple dressings. Herpes zoster is an acute disease, having a definite course and duration; a disease that, if let alone, is sure to get well, supposing the patient not to be very old or infirm. But the vulgar have an idea that, if the disease pass round the body, death from it is certain; and in some parts of the country the poor regard it as a most serious disease. Gangrene of the parts affected in very rare cases follows in infirm aged persons.

The neuralgia which now and then occurs as a sequel to the eruption is best treated by local anæsthetics, as belladonna or chloroform. Not unfrequently it resists all treatment.

Herpes iris is a very rare variety. Each patch is about the size of a sixpence, and constituted by three or four concentric rings of different shades of red. On these rings the vesicles are situated; a solitary vesicle occupies the centre. Willan states that the back of the hand is the most common seat of herpes iris; that it is not connected with any perceptible constitutional disorder; that it disappears spontaneously; and that it is limited to young persons.

Herpes circinatus occurs at all ages. The breadth of the red ring in herpes circinatus varies from a line to a third of an inch; the diameter of the ring from a quarter to two inches; the size of the vesicles from the smallest perceptible by the eye to almost as large as the half of a small split-pea.

When the vesicles are of large size, they undergo the same changes which vesicles of herpes zoster experience; that is to say, at first the fluid in the vesicles is trans-

parent, then turbid, and then the walls of the vesicles and their contents dry up into brownish scabs. A second crop of vesicles may follow; but the disease usually runs its course in a week or ten days. Sometimes several patches of the same kind appear in succession on various parts, and thus the disease may be prolonged for some little time.

As to the treatment of herpes circinatus with large vesicles, a gentle aperient, rest, and a light diet only are required.

That variety of herpes circinatus in which the vesicles are very small is by far the most common and the most important. It is *the ringworm* of the face, trunk, and extremities. From the frequency with which minute scales are found on the red ring, it may be called the furfuraceous variety of herpes circinatus, and to this variety only the following remarks apply.

Herpes circinatus commences as a red spot; and the annular shape is the result of the extension of the inflammation at the margin of the spot, while the centre regains its healthy aspect. It is one of the centrifugal affections of the skin. Occasionally a second, a third, and even a fourth ring is seen within or without the primary circle. Every now and then we meet with cases in which the centre of the ring, instead of regaining its healthy structure as the margin extends, is the seat of repeated eruptions of very minute vesicles, and so has a rough, rather scaly, appearance. This latter form is especially common in strumous children, whose skin is naturally rough. It is peculiarly chronic in its course.

The furfuraceous variety of herpes circinatus is a purely local affection. In this it differs from most of the other species of herpes. In herpes zoster, h. phlyctænodes, and h. labialis, the eruption is preceded by, and is altogether secondary to, a general febrile state. The local affection in these diseases bears the same sort of relation to the general state that the rash of measles bears to the general state that precedes its eruption. Herpes circinatus is not secondary to, or even accompanied by, any constitutional derangement. It differs in another particular from most of the varieties previously described. They are acute diseases; it may be a chronic affection. Each crop of vesicles runs, it is true, an acute course; but repeated crops often give to the disease a chronic character. The furfuraceous variety of herpes circinatus may by the inexperienced student be confounded with roseola annulata, erythema circinatum, psoriasis vulgaris, lichen circumscriptus, and tinea tonsurans. In psoriasis, the elevation of the red ring is greater than in herpes circinatus, and the scales form the prominent feature of the local disease, instead of requiring to be looked for, as in herpes circinatus. There are no elevation of the skin, no vesicles, and no scales in roseola annulata. The abrupt outer margin, the breadth of the ring, the yellowish tint of the centre, and the absence of vesicles and scales, distinguish erythema circinatum. Lichen is a papular disease.

Treatment.—Topical applications only are required for the cure of the furfuraceous variety of herpes circinatus. Local astringents and stimulants are the remedies. The vulgar apply ink, and cure many cases by it. A concentrated solution of sulphate of iron answers well in some cases; so also does a saturated solution of gallic acid. A single application of strong acetic acid, or of a strong solution of nitrate of silver (a drachm to the ounce of distilled water), or of blister-fluid, will occasionally suffice to remove a patch of herpes circinatus which has resisted less powerful agents. This furfuraceous variety of herpes circinatus is contagious. It is almost limited to the young, and is far more common in childhood than in early adult age. In and by itself herpes circinatus is a trifling affection; but considered in reference to the relation it bears to the development of the vegetable parasites, it is a very important disease.

Order 4.—Bullæ.

There are two genera of the diseases of the skin characterised by an eruption of bullæ or blebs, viz. pemphigus or pompholyx, and rupia.

Pemphigus is not an uncommon disease. The bullæ are very perfect. In size they vary from that of a split-pea to half an egg; the larger are not formed by the

coalescence of the smaller. If there be any red margin to the bullæ, it is very narrow; often there is no redness around. In some cases the bullæ are preceded by a red spot of the same size as the coming bleb; the bulla itself having its full circumference from the first, only being less elevated than it becomes in its progress. Sometimes, however, a vesicle appears, and the bulla is formed by its extension in all directions. At first the bulla is transparent; subsequently the fluid becomes opalescent and frequently puriform; at the same time, or it may be before the fluid loses its transparency, the cuticle covering it grows opaque. In the latter case the bulla looks as though it were filled with puriform fluid, and it is only by puncturing it that the chief cause of the opacity is discovered. In cachectic and aged persons the fluid is often sanguinolent.

The fluid of the bullæ in pemphigus resembles the serum of the blood in chemical composition. It is faintly alkaline or neutral so long as it is transparent; when it becomes puriform, it is acid. After attaining its full size the bulla bursts, then the cuticle covering it falls into folds or wrinkles, and, with such portion of the contents as has not escaped, dries and forms a scab. A few days only elapse from the eruption of the bulla to the formation of the scab. The scab or crust varies in thickness; usually it is thin, sometimes foliaceous, never very thick. After a time the scab falls off and leaves a reddish stain or scar, not a cicatrix. Now and then, when the scab is detached, a superficial ulcer is exposed. If the bleb be broken, and the cuticle removed, the surface is excoriated.

In rare cases only one bulla is present at the same time; bulla after bulla on different parts of the surface following each other in succession. This is the pemphigus solitarius of Willan. Usually there are many bullæ present at the same time, and they are either scattered or grouped. When many are seated near to each other, the skin between is usually red, and the lymphatic glands to which the lymphatics of the part lead enlarged and tender. This affection of the glands is out of proportion to the inflammation about the bullæ. The glands rarely, if ever, suppurate. The bullæ of pemphigus are more common on the extremities than elsewhere; but they are often seen on the trunk, genital organs, and face; less frequently on the hairy scalp. Rayer and A. T. Thompson say they have seen bullæ in the mouth and on the velum palati. There seems to be no foundation for the assertion that they are found on the gastro-intestinal mucous membrane.

When present on the soles of the feet or palms of the hands of infants, they are evidence of constitutional syphilis. Pains and heat of the part accompany the development of the bullæ.

Varieties.—1. Pemphigus may occur as an acute disease in young subjects otherwise healthy. The eruption is preceded for two or three days, and is accompanied, by febrile disorder more or less decided. Under these circumstances, the disease runs a course of from one to four weeks. When prolonged for a month, two or three crops of bullæ follow each other; when over in a week, the disease ends with the scabbing of the first eruption.

The occurrence of idiopathic acute febrile pemphigus has been denied by some writers. 'That there is indeed such febris bullosa cannot henceforth well be doubted. Still Rayer's observation, that it is a rare disease, appears correct, since many physicians of large experience have never seen a case, *e.g.* Hebra. I also have never witnessed the acute form.'[1] The writer of this article has seen one case.

2. Persons of damaged health and old people also suffer from a severe febrile form of pemphigus, which runs a quick course.

3. More commonly, pemphigus occurs as a chronic disease, lasting months or even years. This form of the disease is seen in persons of average health, in the cachectic, and at all ages, from childhood to extreme old age. It is unaccompanied by febrile symptoms; but as the chronic course the disease runs depends not on the duration of individual bullæ, but on the repeated eruption of new bullæ, we observe, when they come out in crops, that a little headache, sense of anguor and malaise, and trifling febrile disturbance, precede the eruption.

[1] Gustav Simon, *Die Hautkrankheiten*, p. 194

Synonyms.—The names given by writers to the above varieties are founded, 1st, on the duration of the disease: acute pemphigus, febris bullosa, chronic pemphigus, pemphigus diutinus; 2nd, on the presence or absence of febrile symptoms: pompholyx pyreticus, pompholyx apyreticus; 3rd, on the degree of severity of the general disease: pemphigus benignus; 4th, on the number of the blebs and their arrangement: pemphigus solitarius, pemphigus en groupes.

Nature and seat.—The local affection in pemphigus is secondary to some constitutional or general condition. This is especially clear in the acute febrile variety; for in that form well-marked and sometimes very severe pyrexial symptoms, headache, and languor precede the eruption for two or three days. No doubt certain other symptoms are the direct consequences of the local affection; *e.g.* irritation from sleeplessness, derangement of the digestive organs. Of the nature of the general disease to which the local affection is secondary, we know no more than we know of the nature of the fever which precedes the eruption of small-pox. The fluid of the bullæ is poured out from the surface of the true skin, and collects under the epidermis. There is no evidence to show that the bullæ originate in any of the special structures of the skin.

The lesions found after death have been various evidences of inflammation of the intestinal and urinary mucous membranes, and in almost every case fatty liver.

Prognosis.—Pemphigus is always a grave affection. To the cachectic and aged it is often fatal. As a chronic disease it is most obstinate.

Diagnosis.—Varicella, herpes zoster, and rupia are the diseases said to resemble pemphigus. But there is little danger of confounding it with any other disease when the bullæ are present; their large size, the small amount of inflammation around them, the absence of anything which can be called a base, and their irregular distribution, are peculiarities which permit no mistake in diagnosis. The fever which in rare cases precedes their eruption has no diagnostic characters.

Cause.—Of the causes of pemphigus very little is known. Mental distress, exposure to wet—*e.g.* prolonged stay in water—and derangements of the urinary organs, have all been considered to be predisposing causes. Attempts have been made several times, without effect, to communicate the disease by inoculation of the fluid from the bullæ. Scharlan, however, succeeded in producing bullæ by inoculating himself from an infant four days old suffering from pemphigus. The child appears to have communicated the disease to several persons.[1] In this case the disease was probably of syphilitic origin. Febris bullosa, as acute pemphigus was formerly called, is said to have occurred as an epidemic, and then to have spread by contagion.

Treatment. Local.—Directly a bulla is detected, the cuticle covering it should be punctured with a fine needle. This stays its increase in size. Care must be taken to prevent the cuticle being rubbed off, as the surface exposed will be excoriated, painful, and tender. Dr. A. Todd Thompson recommends that the parts, after the escape of the contents of the bulla, should be pencilled with a solution of nitrate of silver, in the proportion of a drachm to a fluid ounce of water, acidulated with ten or twelve minims of dilute nitric acid. This solution hardens the cuticle and forms a good covering, he says, to the tender surface beneath it. All other local means are useless until scabs form; and then, if these are thick, and several are in juxtaposition, with the skin beneath ulcerated, a poultice of bread and water may be applied with advantage. If the ulcers do not heal after the separation of the crusts, they may be stimulated by nitrate of silver.

The *general* treatment varies with the state of the constitutional disturbance and the general powers of the patient. If the patient be a strong young adult of temperate habits, the pulse full and hard, and the febrile disturbance considerable, benefit will follow abstraction of blood from a vein; but cases requiring, or even permitting, blood-letting are rare. Rest, mild aperients, and spare diet are usually sufficient, even in the acute febrile form, to bring the case to a successful termination.

[1] Caspar, *Wochenschrift für die gesammte Heilkunde*, p. 186, 1841.

When the disease occurs, as is more common, in the aged or the cachectic, bark and ammonia, quinine and the mineral acids, and generous diet, with a moderate supply of alcoholic stimulants, are indicated. Opiates at bedtime are frequently required.

In the chronic apyrexial form the treatment must be regulated by the general state of the patient.

Arsenic exerts little or no influence. (Mr. Hutchinson, however, and many others, regard it as an almost unfailing remedy.) Iodide of potassium is of use only when the disease is of syphilitic origin. Cod-liver oil is sometimes beneficial. Tepid baths have been of service; but occasionally fresh crops of bullæ have followed directly on their employment. If tepid baths are taken, gelatine should be dissolved in the water. Alkaline baths have been recommended for allaying the irritation of the surface. When successive crops of bullæ occur on the same part, the skin at the moment it is free from eruption may be painted with a solution of nitrate of silver sufficiently strong to blacken the surface.

A milk diet has sometimes succeeded when other means have been useless. Cazenave says that he has often obtained good results from giving the patient acorn-coffee.

A case was some time since under the care of the author which resisted all remedies. The child would appear to be nearly well, and then again a new crop made him as sad an object as before. When admitted into the Hospital for Sick Children he had already been suffering for more than two years, and had been into more than one hospital, and under the care of several private practitioners, the parents being well-to-do in the world. He took measles while in the hospital, and from that time was free from pemphigus. There was no return of the affection for a year, *i.e.* when the last report of him was received.

Rupia.—The bullæ in rupia are small and somewhat flattened; their contents very soon become opaque, and are not unfrequently sanguinolent. They are seated on a *very* slightly raised base, and are surrounded by a distinct inflammatory flush. A thick dark-coloured rough scab or crust is formed by the drying up of the bullæ. If not forcibly removed, the scab remains attached for a considerable time. An ulcer, often deep and intractable, is exposed on the removal of the scab.

Sometimes the ulceration extends beyond the margin of the first scab before it is detached, and then a scab forms under the primary one, and of larger circumference; and this process is repeated until a conical crust, of considerable thickness in the centre, and an inch or more in diameter, is constituted. This crust is commonly and aptly compared to a limpet-shell. This variety of rupia is called r. prominens. It is evidence of a profound constitutional cachexia, in the majority of cases, if not in all, of syphilitic origin.

In other cases of rupia the ulceration is the marked feature. The scab is imperfect, and when detached an unhealthy-looking and spreading ulcer is exposed. This is r. escharotica. Sloughs occasionally form on the floor and at the margin of those ulcers; and then the disease has been mistaken for pemphigus, and called p. gangrænosus. In rupia simplex the crusts are of moderate thickness, and the ulcer which follows is neither deep, nor does it exhibit any tendency to spread. Neither scab nor ulcer is remarkable. Hebra holds that r. simplex always precedes r. prominens, *i.e.* that the latter is but an advanced stage of the former; and G. Simon thinks he is right. In fact there is no line of demarcation to be drawn between the varieties of rupia. The one passes by insensible degrees into the other.

Rupia is a chronic disease, and is usually limited to the limbs and loins. It is not contagious, and is almost limited to persons of damaged health. It is common in the cachectic state of the system which so often follows the acute specific diseases. Purpura hæmorrhagica is an occasional complication. Rupia prominens is frequent in the advanced stages of constitutional syphilis. R. simplex is common in children of six or seven years of age. R. escharotica and gangrænosa are limited to young children; the two latter are rare diseases. It is not known what special structure of the skin is primarily affected in rupia.

Rupia is more like to ecthyma than to any other disease of the skin. In ecthyma

there are pustules; in rupia bullæ; but then the serum of the bullæ is soon replaced by a puriform fluid. The red base of rupia is much less raised and decided than that of ecthyma; the scab is thicker and not imbedded, and the ulceration following the scab is greater.

Treatment. Local.—The bullæ of rupia should be punctured as soon as they arise. When scabs are formed, they should be removed, and the ulcers dressed with some slightly-stimulating application. A solution of nitrate of silver is frequently of much benefit.

General.—The subjects of rupia are always cachectic or debilitated. Tonics, especially quinine, are indicated. Decoction of cinchona, with mineral acids, will sometimes agree with the patient when quinine will not. The tincture of serpentaria is sometimes very useful in rupia. The diet should be generous. Wine is generally required, and is borne well even by children.

Order 5.—Pustulæ.

Impetigo,[1] one of the most common of the diseases of the skin, is characterised by an eruption of small pustules, followed by thick rough crusts. The pustules of impetigo are of two kinds; the one pale yellow, flat or rounded on the surface, very slightly elevated above the cutis, and having comparatively little redness around; the other very small, acuminated, and having a red and somewhat elevated base, disproportionately large in comparison with the suppurating points. The latter are achores, the former psydracia. Achores are common on the face of children; psydracia on the scalp and other parts covered by long hair.

The pustules of impetigo are sometimes scattered at a distance from each other, sometimes grouped into clusters on a red ground; and the red ground in the latter case may precede the eruption of the pustules, as it does the eruption of the vesicles in herpes.

The crusts that follow the pustules are always thick; those that succeed to the achores are transparent and tenacious, and resemble in appearance inspissated honey and some kinds of gum; those that succeed the psydracia are either small, separate, and dry, or, covering some extent of the surface, are thick, rough on the surface, and particularly solid.

The lymphatic glands, to which the lymphatics of the part lead, are invariably enlarged in impetigo. This enlargement of the lymphatic glands is not limited to those cases in which there is a considerable amount of inflammation or a copious eruption. A child brought to the physician because of the enlargement of one or more of the lymphatic glands of the neck will frequently be found to have an unsuspected spot or two of impetigo of the scalp. The achores and psydracia are alike accompanied by this glandular affection.

In very exceptional cases the suppurative inflammation destroys the root of a few of the hairs, and thus a very small bald spot remains after the crusts have separated. In the vast majority of cases not one of the roots of the hairs is destroyed. A certain amount of itching frequently accompanies impetigo; in extremely rare cases the pustules are exquisitely painful to the touch, and in still rarer cases intractable ulceration follows the separation of each crust.

The pustules characteristic of impetigo are produced by inflammation of the hair-follicles, terminating in suppuration. Impetigo is thus anatomically and pathologically defined as suppurative inflammation of the hair-follicles. The difference between achores and psydracia is probably due to anatomical differences of the hair-follicles of the face and those of the perfect hair-producing parts, or on the relative proportions of the hair-forming follicle proper and of the sebaceous structures which enter into the composition of the perfect hair-follicle. On the hairy scalp the achores

[1] Hebra considers all cases of impetigo, excepting impetigo sparsa of the extremities, to be forms of impetiginous eczema. The glandular enlargement is sufficient in many cases, however, to distinguish them, as is the strongly alkaline reaction of the fluid in all varieties of eczema.

are almost limited to the occipital region, and especially to that part corresponding to the interval between the insertion of the muscles.

Achores are far more common in the child than in the adult.

The admitted varieties of impetigo are due—to the seat of disease (thus we have i. faciei and i. capitis); to the close approximation of the pustules on a defined inflamed surface, or to their being scattered at a distance from each other, the space between being pale (these differences have given origin to the names i. figurata and i. sparsa); to the character of the inflammation which precedes and accompanies the acute development of the pustules of certain cases of i. figurata (hence the variety i. erysipelatoides); to the thickness and extent of the crust which follows (when the face is covered by a thick crust, the variety is i. larvalis; when a thick crust covers a large surface of an extremity, it is i. scabida—this latter is limited to adults: 'In the lower extremities,' Bateman observes, 'the disease is most severe and obstinate; is ultimately conjoined with anasarca, and often produces severe ulceration;'[1] when the crusts are small, dry, and adhere for some time to the hair after they have separated spontaneously from the cutis, the disease is termed i. granulata); to intractable ulceration following the pustules (it is doubtful, as has been suggested by Cazenave, whether i. rodens, as this variety is named, would not more correctly be placed as a species of lupus); to the duration of the disease, *e.g.* i. acuta, i. chronica. Acute impetigo is not usually preceded by any great constitutional derangement. An inflamed patch pretty well defined precedes the eruption of the pustules. Acute impetigo is always also i. figurata, though i. figurata is sometimes a chronic affection. The duration of acute impetigo is from two to three weeks. Chronic impetigo sometimes lasts for years. The two most obstinate forms are impetigo sparsa of the beard, whiskers, moustache, and inside of the nares; and impetigo scabida of the lower extremities. In the former case the duration is due to the repeated eruption of fresh pustules; in the latter to the continuance of the formation of pus under the old thick crust. No disfigurement to the face results from the most severe impetigo. The crust after a long or shorter time separates, leaving merely a reddish stain, which quickly disappears.

Willan figures six varieties of his genus porrigo: of these—

P. larvalis and p. favosa are merely varieties of impetigo.

P. furfurans is a species of eczema.

P. scutulata is tinea tonsurans.

P. lupinosa is tinea favosa, and

P. decalvans is alopecia circumscripta.

Bateman's description of p. scutulata is most confused; it certainly does not apply to Willan's figure. The latter is a faithful portrait of a common disease; the former applies to no known disease of the scalp, but to separate stages of many diseases having no relation chronologically or pathologically to each other. No age is exempt from impetigo; but i. faciei and i. capitis are more common in children than in adults; while impetigo of the extremities is far more frequent in adults.

The inflamed lymphatic glands occasionally suppurate in children of a strumous diathesis, and when the seat of tubercle.

The characters by which tinea sycosis or mentagra is distinguished from impetigo are well given by Cazenave.

'When impetigo,' he says, 'is limited to the upper lip or chin, it may be mistaken for sycosis; but in the former the pustules are small, arranged in groups; they suppurate completely, and give rise to thick crusts: while in sycosis the pustules are distinct; they suppurate to a small part of their extent only—a sixth or eighth, for example; they give rise to a dry, hard, black scab, which is subsequently, as it were, suspended on the middle of the hair; and finally they are succeeded by tubercular indurations, which constitute a secondary phenomenon of the greatest importance.'

The pustules of ecthyma are larger and seated on a base. The crusts of tinea favosa are dry, of peculiar shape, and a microscopic examination shows their vegetable nature. The vesicles of eczema have no connection with the hair-follicles, though the

[1] *Practical Synopsis of Cutaneous Diseases*, p. 158.

inflammation may involve the hair-follicles of the part, and so eczema and impetigo be combined as in one variety of eczema impetiginodes. The crusts of eczema are thin and pale, and when they crack, oozing of a thin alkaline fluid takes place. The pus of impetigo is slightly acid.

Impetigo appears to be contagious. It is very common to see several children in the same family suffering at the same time. It does not spread, however, as tinea tonsurans so often does, through a large assembly of children, *e.g.* a school. Impetigo evidently spreads by contact, and the pus cannot be wafted, as the spores of the trichophyton can, from one to another. The usual medium of conveyance of the pus of impetigo from one child to another is some article of wearing apparel, *e.g.* a cap or bonnet. Children suffering from impetigo of the head or face often have impetiginous pustules on their fingers from picking the parts primarily affected. Cazenave denies any form of impetigo to be contagious. Willan and Bateman thought that form alone contagious which is characterised by the eruption of achores. Dirt is a very common exciting cause of impetigo, so also are sugar and stone-dust; the foreign particles collect in the orifices of the hair-follicles, and suppurative inflammation of the follicles is the result. Impetigo of the occiput, Mr. B. Squire says, is always due to pediculi. Impetigo shows no special tendency to affect the weakly or strumous, and is certainly rare in the rickety. It is an infrequent syphilide.

Treatment.—In the acute form, a mild aperient, salines, and a simple unstimulating diet, with tepid water as a local application, are generally all the remedies required. When the disease has lasted some time, all crusts must be removed, either by the steam of hot water, or by bread-and-water poultices. It is frequently necessary to remove the hair in order to get the crusts away. The head cannot be shaved; but with a pair of fine scissors the hair can be cut close to the scalp. Patience is needed for this purpose, if the greater part of the scalp be affected. After the removal of the crusts, spermaceti ointment or washed lard, or sweet oil and soap and water, night and morning, often suffice to effect a cure of masses of most repulsive-looking disease. Should these means fail and new pustules continue to appear, a brisk mercurial aperient, *e.g.* calomel and jalap, or calomel and colocynth pill, followed by a grain of quinine three times a day, with ten or fifteen minims of dilute sulphuric acid, will quickly bring the great majority of cases to a successful end. Quinine often seems to act almost as a specific. After the separation of the crusts, a stimulating ointment is sometimes required to prevent the continuance of suppuration. Unguentum zinci; ung. hyd. nitratis; ung. hyd. nit. oxid.; ung. sulph. iodid.; and ung. sulphuris hypochloritis, are all occasionally useful, and one will sometimes answer when the others have failed, and without the reason being apparent.

Several doses of alterative aperient may be required in the course of the treatment. In obstinate cases the waters of Harrogate and those of Aix-la-Chapelle have been found of much service. In impetigo of the parts on which the whiskers, beard, and moustache are seated, and of the inside of the nares, epilation is often essential for a cure. The moment the slightest swelling or redness is seen at the point where a hair emerges from the skin it should be removed. The inner root-sheath comes away with the hair; and if examined microscopically, the epithelium thus detached is found to be swollen; and often when no trace of suppuration is visible externally, pus-globules are found between the hair and the inner root sheath. When the hair is pulled out, the pustule aborts, as it is termed. The iodide-of-sulphur ointment, and bitter-almond emulsion one ounce, are the best local applications. Care must be taken to prevent children tearing off the scabs with their nails. The parts itch and feel stiff; and consequently it is with difficulty children are kept from affording themselves temporary relief by picking and scratching the part.

Ecthyma.—The pustules by which ecthyma is distinguished are the phlyzacious. They are large: rarely, however, exceeding a pea in size; with red, moderately-elevated, and hardish bases. Each pustule is followed by a brown scab, which is very adherent to, and somewhat sunken or imbedded in, the hard base. The scab forms two or three days after the eruption of the pustule. When the crust separates, a deep red stain, a small ulcer, or a cicatrix remains.

Ecthyma runs an acute or a chronic course; the former is, however, comparatively rare.

The acute form is preceded by slight constitutional disturbance, loss of appetite, and deranged alvine secretions; rarely by febrile symptoms. The pustules are generally limited to a small part of the surface; the shoulders and neck are their most common seat. A sharp, burning, pricking pain often precedes the eruption of the pustules. In very rare cases several of the pustules coalesce. The lymphatic glands to which the lymphatics of the part lead are usually enlarged.

The duration of acute ecthyma is one to two weeks. This is the ecthyma vulgare of Willan.

The pustules of chronic ecthyma are scattered at some distance from each other. They are most frequently seated on the extremities, now and then on the extremities and trunk; and in infants they are seen also on the hairy scalp. The long duration of the disease (several months) is due to the eruption of crop after crop of pustules. When the disease affects persons of broken-down health, the pustules are often filled with a reddish sero-purulent fluid; the areola, instead of being red, is dusky or purple; and ulceration of an unhealthy character follows the separation of the scab: this is e. cachecticum.

No variety of ecthyma is contagious.

Chronic ecthyma indicates a low state of the constitutional powers; and e. cachecticum occurs only in the aged and those exhausted by bad diet, over-exertion, mental distress, and other depressing causes. E. cachecticum is sometimes accompanied by purpura hæmorrhagica, and then the areola is purple. This variety has been called e. luridum.

Ecthyma chronicum occasionally follows the acute specific diseases. Pregnancy is said to be a predisposing cause of the disease. It is one of the most common of the syphilides.

Ecthymatous pustules are produced by the application of various irritants to the surface. The grocer's itch, as it is called, is produced by the irritation of sugar. Stone-masons now and then suffer from the same disease. The well-known pustules that follow the inunction of tartar-emetic ointment are examples of ecthyma; only the pustules resulting from the application of this agent are umbilicated.

Scabies is often complicated, especially in young children, by large ecthymatous pustules; as are also, though much less frequently, prurigo and lichen.

The special structure of the skin which is primarily affected in ecthyma is unknown. Biett says that the inflammation originates in the sebaceous follicles: Hilbert and G. Simon, that when tartar emetic is applied to the skin, the orifices of the hair-follicles are first affected; and they attribute the umbilication to the tying-down of the centre of the pustule by the hair-follicle.

Treatment.—In the acute form of ecthyma little is required to be done. One or two doses of alterative aperient, followed by simple salines; a simple but not too low diet; and tepid water frequently applied to the inflamed part, are all that are necessary and useful.

In the chronic forms the health is generally and sometimes very much deranged; the patient weak and exhausted. Generous diet, moderate quantities of wine, quinine, or bark, and the mineral acids, serpentaria, and cod-liver oil, and steel, are one or all necessary to effect a cure. Daily tepid baths are useful. Taraxacum and sarsaparilla, with nitro-muriatic acid, seem occasionally to be of much benefit. Opiates are sometimes required at night.

Order 6.—Papulæ.

Strophulus, or red gum, as it is vulgarly called, is a common papular disease proper to children from birth to the end of the first dentition. It is characterised by the eruption of small papulæ, red or paler than the healthy skin, scattered or grouped, and attended by trifling itching.

Many writers on diseases of the skin consider strophulus and lichen to be the same disease.

Several varieties have been described and most admirably figured by Willan. When the papules are scattered over the skin, with small red spots interspersed among them, the disease is called s. intertinctus. When the papules are crowded into groups, and the skin between is more or less red, it is s. confertus. 'Sometimes,' Bateman says, 'though rarely, a variety of the s. confertus appears on the legs, spreading upwards even to the loins and navel, producing a general redness of the cuticle (not unlike intertrigo), which cracks and separates in large pieces, occasioning much distress to the child. It is liable to recur at short intervals for the space of two or three months.' It is in children of seven or eight months old that this severer form of s. confertus occurs. When, for three or four weeks, circular patches of papules appear in succession, each patch lasting four or five days, the disease is s. volaticus.

Strophulus candidus is the name applied to an eruption of white, rather large, papules, which appear occasionally on the loins, shoulders, and upper arms of children of about a year old. There is a danger of mistaking the hard pale elevations produced in some children by the bite of a flea for this disease; a vesicle sometimes results from the bite of the same animal.

Strophulus albidus is a rare disease. It is doubtful if Bateman (judging from his description) ever saw a case. Willan's figure is perfect. The so-called papules are really sebaceous follicles, distended by their secretion. The small elevated opaque dead-white spots scattered in numbers over the face are so striking in appearance as at once to rivet the attention.[1] Willan's strophulus albidus is, then, a form of acne. Hebra it was who pointed out the real nature of this affection.

Strophulus is a disease of no practical importance. It is not contagious. It generally depends on some disorder of the stomach and bowels of the child; this being itself often secondary to dental irritation, or to improper diet.

Treatment.—A knowledge of the causes of strophulus points to the treatment. A gentle antacid aperient, as rhubarb and magnesia with an aromatic; or an antacid without any aperient, as the mistura cretæ, should be given; attention should be paid to the diet, which is so often faulty in the child, and the use of the gum-lancet may be required. The eruption is of use, by pointing the attention to some error which, if allowed to go on uncorrected, might lead to more serious trouble. It is only in the gravest form of s. confertus that occasional bathing with faintly alkaline gelatine water is required.

Lichen.—The papulæ of lichen are very small solid elevations of the cutis, perceptible to the touch, redder than the adjacent skin, which cannot be even temporarily removed by pressure, though they may be made for the instant paler. The papules itch and tingle. As the redness fades, and the papules disappear, trifling desquamation of the cuticle over them takes place. Lichen commonly affects a limited part of the surface only, *e.g.* the hands, forearms, trunk, face. The back of the hands and the outer aspect of the forearms are common seats. The papulæ are generally arranged in groups.

Lichen occurs in an acute and in a chronic form. Lichen simplex is accompanied, and sometimes preceded, by trifling febrile disturbance. The papules are bright in colour, and appear first on the face and arms, then extend to the trunk and lower extremities; it is an acute affection, lasting from ten to twenty days. It has been mistaken for measles and for scarlet-fever. L. simplex occasionally returns at long intervals in the same individual.

Lichen circumscriptus, l. urticatus, and l. lividus, may be regarded as chronic varieties of lichen simplex.

In lichen circumscriptus the papulæ are arranged in irregularly circular groups. As those first evolved fade, others appear at the margin of the patch; in this way the disease may be prolonged for many weeks. Lichen gyratus, in which the papules

[1] In University College Museum there is an excellent wax model, by Mr. Tuson, of the face of a child suffering from this disease. It was made from a patient of the writer's.

are arranged so as to form a twisted band, is probably a form of lichen circumscriptus of syphilitic origin.

Lichen lividus is seen in old persons, and chiefly on the lower extremities. The papules are dusky red, or livid, and frequently purpuric spots are interspersed among the papules. Hebra considers it to be a species of purpura, and calls it purpura papulosa.

In lichen urticatus, the more permanent papules are preceded by small wheals; the papules becoming apparent as the wheals subside. The papules are throughout the whole course of the attack larger than in any other variety of lichen. Hebra and G. Simon consider it to be a variety of urticaria, and call it urticaria papulosa.

Lichen pilaris is distinguished by the passage of a hair through the centre of each papule. It is probable that it would, as G. Simon has stated, be more correctly described as a variety of acne.

Lichen agrius is a much more serious variety. A considerable amount of local inflammation attends the eruption of the papules, which are usually limited to circumscribed patches of some extent. The heat, tingling, and itching are very troublesome, and the scratching to relieve the last-mentioned symptom increases the local inflammation. Warmth and internal stimulants, alcoholic or other, increase the itching. Lichen agrius may disappear in a fortnight or three weeks; usually, however, it runs a chronic course, crop after crop of papules appearing on the inflamed patch. Ultimately the skin of the part becomes thickened and cracked; a serous oozing may take place from the surface abraded by the nails, and suppurative inflammation may be set up, and then crusts of various degrees of thickness are formed on the surface. Lichen agrius in this state may be mistaken for psoriasis, for eczema, or for eczema impetiginodes; and it is only by the history, and by a careful examination of the margin of the patch, that the primary nature of the affection can be determined.

The prickly heat of hot countries is merely an aggravated form of lichen simplex. It is called lichen tropicus.

Hebra has described a very rare form of lichen, to which he has given the name l. ruber. It has also been termed l. planus. At first there is an eruption of miliary papules; the eruption is accompanied by very little itching. The papules increase in number till they occupy entire regions, or even the whole surface of the body. The appearance of the disease is then quite peculiar. The integument is universally reddened, covered with numerous thin scales, and so infiltrated that when a fold of the skin is taken up it is found to have more than twice the normal thickness. The flexion of the joints may be impeded by the thickened skin. As the disease spreads over the whole surface, the patient falls into a state of marasmus, and the case generally ends fatally.[1]

Lichen is not contagious. Persons of a nervous, excitable temperament are specially liable to it. Women more frequently suffer than men. It is more common in spring and summer than in autumn or winter. Some derangement of the stomach or intestines is usually connected directly with the attack.

The investigations of Gustav Simon seem to prove that the papules of lichen, strophulus, and prurigo are not, as some have asserted, the papillæ of the skin inflamed or enlarged. They have no connection with the papillæ; but are produced, according to the same observer, by the effusion of serosity into the substance of the skin. Lichen, strophulus, and prurigo are considered by Cazenave to be primarily lesions of sensibility—true nervous affections; the degree of itching bearing, he says truly, in many cases no relation to the number of the papules.

Treatment.—A mercurial at bedtime, followed by a saline aperient in the morning, once or twice a week, a carefully regulated, simple, unstimulating diet, the avoidance of heating exercises and clothing, a well-ventilated room, and a gelatinous or mucilaginous bath every night to allay irritation, will bring the majority of cases of lichen to a favourable termination. When the inflammatory symptoms have been

[1] *Sydenham Society's* edition of Hebra, vol. ii.

reduced, and the disease has assumed a chronic form, arsenic will effect a cure. Fowler's solution (liquor arsenicalis) in five-minim doses may be given three times a day. Sulphur-baths have proved useful in some cases. It is rarely that local stimulating applications are of service. Ointment containing calomel and camphor, and iodide of mercury, are recommended by Rayer; but certainly prove injurious in the great majority of cases which seem best suited for their employment.

Bark with dilute sulphuric acid, and a generous diet with wine, are the proper remedies in lichen lividus.

The most obstinate forms of lichen are l. pilaris and l. urticatus. In the treatment of the former the inunction of lard every night, followed by an alkaline bath, soap and water, and friction, are most useful. Sponging the parts with vinegar and water, or lemon-juice, will sometimes allay the intolerable itching in l. urticatus. The subjoined lotion is recommended by Dr. Thompson for the same purpose :—

℞ Acid. hydrocyan. dil. ʒjss.; potassæ liquor. ʒj.; aq. rosæ ℥ vss. M. This lotion to be applied to the part when the itching or pain are troublesome. For l. ruber the remedy is arsenic in full doses.

Prurigo is characterised by a scattered eruption of very slightly raised, flat, and rather broad papulæ, differing little, if at all, from the colour of the skin. These papules are the seat of troublesome itching. It is sometimes very difficult to detect the papules, in consequence of their colour, their flatness, and their breadth. Sometimes they appear, as it were, buried under the cuticle, and the papules which can be discovered by the most careful examination are often very few compared with the severity of the itching. Stimulating drinks, spices, heating exercise, trifling contact of the clothes, and change of temperature increase this most troublesome symptom. Sometimes the patient, comparatively free during the day, no sooner is warm in bed than the itching becomes so intolerable as altogether to prevent sleep. The excessive itching of the papules never fails to lead to their apices being torn by the nails. Blood and serosity ooze from the abraded surface, and a little black crust occupies the summits of many of the papulæ. The lines of abraded cutis, so common in scabies, are comparatively rare in prurigo. In the latter it is the papule itself which is torn. When the itching is accompanied, as it sometimes is, by a sensation as of insects crawling over the part, the disease is called prurigo formicans. This is a most obstinate and severe variety. Wheals of urticaria occasionally appear when the part is rubbed or scratched violently. Prurigo is common in the aged; the itching being most constant and severe, the patient having little rest day or night. When prurigo occurs in old people, it is called p. senilis. By the irritation and want of sleep it occasions, p. senilis has sometimes shortened life. It is in old persons especially that the papulæ most easily escape detection. P. formicans and p. senilis are usually very obstinate, lasting months and even years. When the itching is moderate in severity, as is not unfrequently the case in young persons, the disease is p. mitis. This variety disappears in from a few hours to a few days.

There is no line of demarcation to be drawn between these three varieties of prurigo. The greater or less degree of itching and the age of the patient are very insufficient grounds for the foundation of species. Hence it has been proposed to divide prurigo into general and local prurigo.

The shoulders, neck, and outer aspect of the arms, are the most common seats of prurigo.

Old persons who suffer from prurigo are also frequently the subjects of lice; and it has been supposed that the condition of skin on which the prurigo depends is favourable to the propagation of the lice. G. Simon, on the contrary, thinks that it is in many cases the rubbing and scratching of the skin consequent on the presence of the lice which induces the papular eruption. No doubt the want of cleanliness, so common in old age, is a cause for the presence of the parasite and of the eruption.

The papules of prurigo bear a close resemblance to those of scabies; and cases of scabies, in which vesicles are few and not very perfect, have repeatedly been mistaken

for prurigo. Bateman says p. mitis often terminates in scabies: he might more correctly have said scabies is often mistaken for prurigo. 'As to the changes of the skin in prurigo, I,' writes G. Simon, 'endeavoured to satisfy myself by the examination of papules, which I cut, with a small piece of the adjacent skin, from living people; and I found exactly the same state as in lichen. The epidermis was not detached, the papillæ of the skin were not enlarged, and the fibres of the cutis were unchanged.' He concludes that the papule in prurigo, as well as in lichen, is produced by the presence of serosity in the substance of the skin at this spot. If a papule of prurigo be punctured with a fine needle and then compressed, a clear fluid oozes from the wound; if a papule of lichen be punctured with equal care, blood escapes. Simon attributes the difference to the greater vascularity of the papules in lichen, and the consequent impossibility of not puncturing a vessel. The little serosity that would otherwise be visible is concealed by the blood. Hebra says each papule is formed by a collection of fluid in the deeper layers of the epidermis.

Prurigo, like lichen, is considered by Cazenave to be a disease of sensibility. Of the origin of the nervous affection, nothing is known. The retention of some of the urinary constituents in the blood has been stated, but hitherto without proof, to be a cause of prurigo. The itching of the skin in jaundice is familiar to all; and in some cases in which that symptom has been most marked, a papular eruption has been present. Whether in these cases the papular eruption is the consequence of the scratching, it is impossible to say. The subjects of prurigo often suffer from hæmorrhoids.

Treatment.—If the patient be young and strong, the diet should be simple and unstimulating, and the bowels kept freely open by such a mixture as the following, taken two or three times a day: ℞ Magnes. sulph. ʒjss.; acid. sulph. dil. ♏xv.; inf. gentian. co. ℥jss. Misce. A dose of calomel and colocynth, or blue-pill and colocynth, should also be given at bedtime once or twice a week. Tepid alkaline baths should be used every other night. Sulphur vapour-baths are useful when aperients are no longer indicated by the pulse and general state of the patient. Sea-bathing has sometimes effected a cure.

In the aged, and in young persons of broken health, good diet and even wine are required. Tonics, especially quinine or bark with mineral acids, are useful. Frequent washing with soap and water, and daily change of body-linen, are essentials. Tepid alkaline baths and sulphur vapour-baths are also of much service. Diuretics and cholagogues have been given when the disease has been supposed to depend on the retention in the blood of the urinary or hepatic secretions.

Cazenave says, that since lichen and prurigo are really true neuralgic affections, they should be treated as such. And he adds that the practical results he has obtained afford fresh proof of the correctness of his views as to the nature of these most troublesome affections. 'In the majority of cases the employment of antispasmodics or of antiperiodics suffices,' he says, 'to modify completely the hyperæsthesia. I have had recourse,' he adds, 'with happy results to ammoniacal sulphate of copper, to datura-stramonium, to extract of aconite.' The last he gives thus: ℞ Extract. aconit. gr. xv.; conf. rosæ q. s. ut ft. pil. xx. One pill night and morning. Sulphate of quinine he gives in doses of from 3 to 5 grains per diem, and continues it for one or two weeks. Of liquor arsenicalis, in common with all writers on this subject, he speaks in the highest terms; but he considers that it acts not only by modifying the action of the skin, but also as an antiperiodic.

Local prurigo.—There are many species of local prurigo, but they differ only in their seat: thus there are p. podicis, scroti, pudendi, præputii, urethralis, &c., according to the part affected.

Local intolerable itching is always called prurigo, but it is by no means always the consequence of a papular eruption. Itching of the anus and of the labia pudendi is a common consequence of congestion of the large veins of the parts, of hæmorrhoids, of ascarides in the rectum, of an overloaded lower bowel, of the early stage of cancer of the uterus and lower bowel. Local eczema is a common cause of intense itching.

Treatment.—Cleanliness and the avoidance of scratching are the first essentials

to a cure. If the anus be the seat of the trouble, it should be washed after stool and then carefully dried. The liver and bowels should be freely unloaded, in order that all congestion of the parts due to impediment to the onward flow of the blood in the portal vein may be removed. Leeches to the anus are often useful when it or the parts in its vicinity are the seat of the prurigo. Tepid water, or lotions containing an alkali, opium, prussic acid, acetate of lead, calomel and lime-water, acetate of ammonia, vinegar, have all been used with advantage, and have all failed in other cases to afford relief. The bichloride of mercury and lime-water, two grains to the ounce of lime-water, is one of the most efficacious local applications. Ointments containing lead, nitrate of mercury, or ammonio-chloride of mercury, sometimes check the itching when the lotions recommended have proved useless. The patient should always keep the preparation which answers best by his bedside, so that when the heat of the bed renders the itching severe, he may bathe or anoint, instead of scratching, the part. When eczema is the cause of the itching, a solution of nitrate of silver and the ung. sulphuris-hypochlor. are the most frequently successful applications.

Order 7.—Squamæ.

Pityriasis.—Trifling redness of a limited portion of the skin, with furfuraceous desquamation of the cuticle covering the part, are the characters by which pityriasis is known. Pityriasis capitis is the most common variety. This is the disease known to nurses by the names scurf and dandriff. The head itches, and directly it is rubbed, quantities of little scales, formed of epithelium, are detached. A similar affection occasionally occurs at the bends of the joints and over a limited extent of the trunk. When it has existed for some time in a severe form on the head, the hair often comes out in considerable quantity. It grows thin, but does not come off in patches, or to such an extent as to cause baldness.

Pityriasis rubra is the name formerly, and often still, applied to the disease when the redness is more decided, and there is roughness, rather than detached scales, on the surface. It occurs in patches. The most common exciting causes of p. rubra are exposure to the rays of the sun or to a cold dry wind ; and frequent wetting of a part of the skin and then drying of it by evaporation. Children often produce pityriasis rubra of the lips by wetting the surface of the skin around the mouth with the tongue. No doubt many of the cases called pityriasis rubra are really examples of the driest forms of eczema.

The term *Pityriasis rubra* has also been applied by Hebra to a specific disease of the skin, quite distinct from all the recognised varieties of pityriasis, but presenting a close anatomical affinity to psoriasis, or to eczema in its chronic desquamating stage. This use of the term has of late been generally adopted.

Hebra's p. rubra is a rare disease of very chronic progress. It occurs for the most part in persons who are otherwise in the enjoyment of good health, and appears to be incurable. It commences with congestion of the skin, which is either universal from the beginning or soon becomes universal, and is speedily attended with a tendency to the abundant formation and separation of the epidermis in large dry flakes. There is little or no infiltration or thickening of the congested skin at any time, and little or no itching or other sensory discomfort. The congestion and desquamation, however, persist, and the scales often accumulate or are shed in considerable quantities. The nails are apt to suffer as they do in eczema and psoriasis. For the most part the health does not suffer. But it is said that after the disease has persisted for many years the skin is apt to become tender and more or less disorganised, and the patient is apt to fall into ill health attended with loss of appetite, emaciation, and debility.

The disease chiefly resembles chronic eczema and psoriasis. But there seem to be obvious differences. Its onset and early phenomena appear to be characteristic. There are no vesicles and papules, and no fluid exudation as in eczema. It does not occur in patches, as eczema and psoriasis usually do. And there is (at any rate until quite the latest stage) an absence of the thickening and cracking of the skin which are observed in the chronic and diffuse forms of eczema and psoriasis.

Treatment.—A solution of borax as a detergent, mild astringent ointments, and the avoidance of hard friction, as by the use of a hard hair-brush, are usually all that are needed in the treatment of pityriasis capitis. If these means fail, or if the disease be very troublesome, the following liniment will be found a valuable aid: ℞ hydrarg. ammon. chlorid. ʒj.; ol. olivæ ℥j. M. To be applied to the head with a camel-hair pencil. When the hair falls out, a local stimulant often stays the mischief. Equal parts of acetum cantharidis and spirits of rosemary form a good liniment.

In simple pityriasis rubra, zinc ointment and the avoidance of exposure to the exciting cause generally effect a cure.

Aperients are frequently required. In severe, extensive, and obstinate cases, vapour and sulphur baths are often useful.

For Hebra's pityriasis rubra, warm baths and oleaginous and other emollient applications are serviceable.

Psoriasis.—The disease now commonly known by the name of psoriasis was formerly, and is still by some, divided into two genera, viz. psoriasis and lepra. This distinction is based on no real difference between the two affections.

Psoriasis is a chronic disease characterised by slightly-raised red patches covered by white shining opaque scales.

The varieties of psoriasis are founded on the shape, size, number, or situation of the patches. Thus, when the spots are circular, small, numerous, and irregularly scattered over the skin, the disease is p. guttata; when they are long and broad, it is p. diffusa; when they are ring-shaped, the centre assuming a healthy appearance while the disease is spreading at the circumference, it is p. vulgaris or p. circinata. It was to patches of psoriasis of this shape that the name lepra vulgaris was applied. When the patches are in the form of twisted bands, a very rare variety, it is called p. gyrata.

As to the varieties named merely from the part affected, there are p. præputialis, scrotalis, labialis, palpebrarum, palmaris, dorsalis, &c.

Psoriasis in all its forms runs a very chronic course, lasting not infrequently for many years. When cured, it is prone to recur. Some persons have an attack of psoriasis every year, some two in a year. Spring and autumn are said to be the seasons when these attacks occur.

The spots of p. guttata are from a quarter to half an inch in diameter, their centres are raised, and as they fade their centres heal first. P. guttata occurs on the trunk and extremities. The spots are often irregularly scattered over the whole surface. It is common for a few spots to be present in other varieties of psoriasis. The twisted bands of p. gyrata are said to be formed by the close approximation of separate spots of p. guttata.

P. diffusa begins in rather broad irregularly-shaped angular patches, which subsequently coalesce. Its most common seat is the extremities. The front of the leg, from the patella to the ankle, is occasionally covered with an unbroken patch of p. diffusa. The outer aspect of the forearm, from the elbow to the wrist, is also now and then the seat of a similar large patch. When p. diffusa is very severe and long continued, it has been called p. inveterata.

When the ring-shaped patches of p. vulgaris attain a very large size, the scales are sometimes wanting over a considerable extent of the ring. Under such circumstances there is a large red elevated ring, with patches of scales here and there. Within this ring are occasionally rings of p. vulgaris entirely covered with scales. The local accumulation of scales in psoriasis of the scalp is often enormous. When psoriasis affects the backs of the joints of the fingers, most painful cracks form; the scales in this situation are few. The itching is very troublesome in some forms of psoriasis, attaining its maximum when the disease affects the scrotum or the labia pudendi.

Dr. McCall Anderson, in his work on psoriasis and lepra, has described a form of psoriasis in which the scales are very thick, and so much thicker in the centre of the

patch than at the circumference as to give to the patches on a superficial examination the appearance of crusts of rupia.

The red patches of psoriasis are due to inflammation of the cutis; the scales to excessive formation of epithelium on the inflamed surface.

Neuman ('Wochenblatt der Gesellschaft,' 1867), from his minute researches into the local structural changes in psoriasis, concludes that psoriasis is an affection of the skin involving chiefly the papillæ and the superficial layer of the corium, of which the characteristic feature is the excessive formation of epidermis.

Inflammation of the skin, attended by the effusion of the ordinary products of inflammation, leaves behind, supposing the patient to be disposed to the disease, a state of the part favourable to the formation of a patch of psoriasis.

Thus a lad was in University College Hospital suffering from psoriasis. The disease had almost disappeared, when herpes zoster occurred, ran its ordinary course, and healed; but no sooner had the scabs separated, and that stage been reached in which only a faint red stain indicates the seat of the herpetic patches, than each reddish spot covered itself with scales—in fact was converted into a patch of psoriasis. A blister was subsequently applied to the lad's thorax. When it had healed, and the stage of simple redness was reached, the part on which it had been placed covered itself with scales. It may be, of course, that the herpetic inflammation and the inflammation excited by the blister acted especially by stimulating the vessels or the nerves or the formative power of the part. Probably all were affected; the formative power being disproportionately affected from the general state of the health.

As bearing on this question, it is interesting to note that, in p. guttata, if the points at which the spots are originating be carefully sought out and examined, the redness and the scales will be seen to be forming at the orifice of the hair-follicles, not in all instances, but in the majority.

Psoriasis occupies the drier and coarser parts of the skin. Hence it is most common on the knee, just under the patella; and at the elbow, on the skin covering the olecranon process of the ulna. In regard of situation, it occupies the parts which differ most in texture from those occupied by eczema. When the patches are very numerous or very large, and spread from the back to the front of the arm, or from the front of the knee to the ham, the disease is worse or more extensive in the coarser-textured parts. Thus parts at which the sweat-glands are the most abundant are the chosen seats of eczema, while the same parts are rarely the seat of psoriasis.

The loins, according to Mr. B. Squire, are more frequently affected than any other parts of the trunk.

Psoriasis is often connected with deranged stomach, and especially with a very subacute gastritis.

It is never communicated from one person to another. A tendency to psoriasis is undoubtedly hereditary. Psoriasis is a common syphilide. Whenever it affects the soles of the feet or the palms of the hands, the probability of its origin in constitutional syphilis should be investigated.

Care must be taken not to confound eczema of the palms of the hands with psoriasis of the same part. There is occasionally a difficulty in separating the two. In fact, eczema of this part is occasionally figured as psoriasis; the thickness of the cuticle prevents its being raised into vesicles, the fluid formed is small in quantity and escapes notice; the consequence is that the chief feature of the case is the peeling of the skin of the palm. The most frequent exciting cause of the eczema, viz. carbonate of soda used by women in washing, &c., so changes the cuticle as to aid in the production of a similarity between the two affections. Excluding, then, the syphilides, psoriasis of the palm of the hand is a much rarer disease than is generally supposed, and non-syphilitic psoriasis of the soles of the feet is very rarely, if ever, seen.

The drier forms of eczema of the neck, extremities, and trunk are occasionally mistaken for psoriasis. The different situation occupied by the two diseases suffices at once to prevent the error, by suggesting a doubt as to the case being what it at first sight resembles. A careful examination of the part shows the apparent scales of eczema to be formed of dried vesicles.

Treatment.—Attention should in all cases of psoriasis be paid to the state of the stomach, in order that anything approaching to subacute gastritis may not escape

observation. Should it be indicated, then the diet must be carefully regulated, and the internal affection made the first object of treatment. In cases where there is no evidence of an inflammatory state of the mucous membrane of the stomach, the treatment is determined by the state of the local disease, and by the general condition of the patient; if the patches be hot and bright red, an antiphlogistic regimen and venesection, or aperients, or both, according to the age, the pulse, and the strength of the patient, are to be first employed. Should there be no unusual heat of the part from the first, or after the active symptoms have been subdued by the remedies above mentioned, liquor potassæ, iodide of potassium, tincture of cantharides, and especially arsenic in the form of Fowler's solution, are the most potent internal specifics. Liquor potassæ and iodide of potassium require to be given in full doses in a large quantity of some bland fluid.

Tincture of cantharides, an old remedy, was employed by Biett, who thought very highly of it, and by it alone cured a large number of obstinate cases. The dose to commence with is five minims twice a day; it may be gradually increased till thirty or forty minims are taken, in divided doses, during the day. Its action must be carefully watched. Nausea, colic, diarrhœa, and troublesome erections of the penis, are said by Cazenave to be the occasional consequences of its employment.

Arsenic, however, is undoubtedly the most potent of the remedies used in the treatment of all varieties of psoriasis. The dose of Fowler's solution is three minims three times a day, gradually increased till eighteen or twenty minims are taken, in divided doses, during the day. Each dose should be taken on a full stomach, *i.e.* directly after meals. Its effects must be attentively watched. When any signs of its disagreeing occur, it should be omitted for a few days, and then resumed in smaller doses. The evidences of too strong action are inflammation of the tarsi, ophthalmia, nausea, colic, diarrhœa, and a troublesome, dry, paroxysmal cough. Other internal remedies which have been said to be occasionally of service are the decoctions of dulcamara and of mezereon, bichloride of mercury, calomel, and pitch. The decoction of dulcamara may be used with advantage as a vehicle for the more potent tincture of cantharides and liquor potassæ arsenitis. Copaiba in small doses, originally recommended by Hardy, is said to have proved efficacious in cases not benefited by arsenic. (Liveing, 'British Medical Journal,' November, 1869.)

Local remedies suffice in many cases for a cure; though in all local are greatly assisted by internal remedies.

The most potent external application is unguentum picis. The addition of a little creosote increases its efficacy. Nitrate of mercury ointment may be used when the patches are of small extent. Tepid, vapour, and sulphur baths are all occasionally of service.

Ichthyosis is properly classed with the squamous order. The name, derived from a fancied resemblance which its scales bear to those of a fish, refers rather to their abundance than to their arrangement, as the absence of imbrication marks the complaint in every stage and variety. In many cases the scales are very thick, disposed as so many small squares, and often rendered dark or nearly black from continued exposure; they are specially developed in the vicinity of the joints, as the knees, ankles, and hips; occasionally on the clavicle, and in females around the nipple.

A good illustration of ichthyosis is afforded in the following instance of S. B., a girl 14 years of age, admitted into hospital in 1864. The scales covered every part of the body, except the soles of the feet and the palms of the hands, where the skin was only rough; they were also absent on the ball of the thumb and the upper lip. Their greatest development was attained on the hips and elbows, but the neck, back, and outer surface of the limbs were severely affected. The large scales were irregularly fissured, and some of them curled at their margins. Thickest on the knees, they existed as large flakes on the abdomen and the thighs. The forearms on either aspect were covered with dark rectangular scales, which became circular or oval towards the wrist, and slightly depressed in their centre.

Ichthyosis is always congenital, and should be considered rather as a malformation than as a disease. It is never contagious.

Such are the characters of ichthyosis as they occur in extreme examples. There are, however, many cases no less typical, but which differ from the preceding chiefly in the disposition of the scales. The latter are notable for their size and tenuity, as well as for the rapidity with which they are shed and again renewed. The skin also inclines to a reddish hue.

In a *third* kind, an intermediate stage is represented between what might be termed pityriasis and ordinary ichthyosis. It is a far more frequent species than those just described, and its scales are thinner and more abundantly diffused than in the latter affection. In common with the rest, this complaint is congenital, and as such it differs from hereditary psoriasis in not being declared, or at any rate most rarely so, at the time of puberty, or yet at a later age. The most usual period for its primary manifestation is from the third to the sixth month, and seldom is it delayed beyond the first year. It commences generally on the scalp and face, sometimes on the back, extending from thence over the whole surface, and varies from one to two or more years before its entire effect is accomplished. In some of the worst instances of its occurrence, it is associated from birth with a deficiency of the eyebrows and eyelashes; and in cases less pronounced these may be but partially present. Although at its origin the face is usually involved, the disease in its progress sometimes appears partially to forsake this part, and to become finally more confirmed on the loins and legs. The patient's garments or bed-clothes, as in psoriasis inveterata, will be constantly covered with numerous scales, which are regenerated almost as soon as shed. The skin everywhere feels preternaturally rough and dry, not excepting the hands and feet; and one distinguishing element of the complaint to be often noted consists in that absence of perspiration, which, in cases of severity, would seem to be complete, the skin retaining its dry character even in the hottest day. As might be anticipated, the condition of the patient thus situated depends in no slight measure upon the seasons, the disease being found to yield to the influence of mild weather; while, on the other hand, it is readily affected or increased by cold. In winter, or in a piercing wind, the patient is pretty sure to suffer, particularly on any surface uncovered, as the face or fingers; or should he afterwards approach the fire or become otherwise heated, the same parts tingle and smart. A similar result will sometimes follow exposure to the sun's rays in summer; which, without flaying the skin, produce great irritation in such a locality as the face. In other cases the feet, around the heels, are apt to become fissured and painful after walking, or much inconvenience is occasioned from the friction of the scales in front of the ankle or at the groin.

A yet lower type of ichthyosis—the lowest of all—I would beg to subjoin. The subjects of it are distinguished by a similar want of perspiratory action of the skin as in the last named, or by its limitation to some particular region. This may be, and most generally is, the palmar or plantar surface, or the axillæ, or the face and neck; and I have known a small space on the loins, or the front of the chest, the only part capable of secreting. Sometimes the spot thus selected constantly perspires, or it is only the great heat of summer which induces it to do so. Again, the presence of scales, although so prominent a feature in all other forms of ichthyosis, is not remarked here; and scarcely can the hand, much less the eye, detect any appreciable difference in the integument from that of the normal state. Such patients are often remarkable for a redness or freshness, as it might be said, of the cheeks; and particularly is this noticeable after the least excitement or exertion. That these cases do in reality pertain to the class under our present consideration is sufficiently attested by the hereditary nature of the complaint, and by the evolution of its higher grades in other members of the same family; and not seldom its occurrence in direct descent. One complication I must likewise add, which, almost always overlooked, deserves mention in this place—I mean its occasional association with prurigo. The latter is in many instances severe, and productive of the utmost annoyance to the patient, whom it may affect at any age, from early life to youth, and beyond it. Towards night especially, exacerbations are wont to occur, as on approaching the fire, or the same takes place from exposure to cold. That this kind of prurigo is dependent upon

the state of the skin itself, and not due to any parasitical influence, is, I think, proved to demonstration by the absence of any such exciting cause, and by the remedies successfully employed for its removal.

The total arrest of all sensible perspiration in ichthyosis, and its partial secretion only in some of the modified forms of this complaint, offer an interesting subject for investigation with respect to the state of the urine. The result of certain experiments which I undertook some few years since on this question[1] pointed to the following conclusions. A considerable increase in bulk was observed in the urine, which was only faintly acid, and of low specific gravity; the rate per cent. of urea was small, although its absolute amount remained nearly the same—a fact which militates against the usually received theory of the elimination by the skin of urea; lastly, the phosphoric and sulphuric acids were hardly, if at all, affected.

Most writers have dwelt on the greater frequency of ichthyosis in the male as compared with the female. My own observations, derived from no inconsiderable number of cases, rather incline the other way, and certainly do not support the opinion that ichthyosis is a special complaint of either sex. Instances have come under my notice of ichthyosis invading the male children only in one family, and in another the female; of its affecting both sexes, the offspring of the same parents; and again of its appearing in a single member alone. The hereditary nature of ichthyosis in some examples is unquestionable; and I have recorded one, in which there was evident proof of the direct transmission of this affection though six successive generations. Instead of proceeding in an immediate line, it will sometimes show itself in a collateral branch of the family; and cases are not rare in which, as far as can be ascertained, no claims of lineage are allowed.

Ichthyosis may exist in the fœtus, and in a most aggravated form. In these cases, the skin appears tightly stretched throughout, and over the trunk and limbs it is ruptured in transverse or parallel lines. The eyes are fixed in consequence of the rigid state of the lids; so likewise are the lips, which are converted into hardened bands, and expose the gums; and no vestige of an external ear is seen. The entire body presents an assemblage of lozenge-shaped spaces or intervals, caused by a separation of the fibres of the cutis, sufficiently numerous and distinct to warrant the appellation of a 'harlequin' fœtus, which is allotted to it. The only museum, as far as I am aware, in the possession of this remarkable class is that of Guy's Hospital, which contains four excellent specimens of this singular deformity of the skin. Although it is to be regretted that no history is attached to them, I was fortunate in learning from Mr. Scarr, of Bishop's Stortford, who presented one of the above preparations to the Hospital, that not only was the mother's labour in this instance perfectly natural, but the fœtus lived for some seconds after its birth: it was the only one of several children that exhibited any indication of ichthyosis, and no hereditary trace could be obtained. I may add, that by the parent the complaint was attributed to a sudden and severe fright she experienced, when attending a country fair at the time of quickening.

Hitherto I have considered ichthyosis as general, and therefore complete; but it is by no means invariably so. Instances are often met with in which it occurs only in a partial form. These betray a roughness of surface varying in degree and extent in different cases, but chiefly observed on the outer aspect of the limbs and on the loins, and most of all in the vicinity of the knees or other large joints. The scalp participates, but irregularly; it may exhibit at a single spot a large, thick, and irregular crust, very adherent, and covered with hair; or in other cases, separate white patches, scarcely raised, but equally tenacious as the last, and penetrated at various points by hair. In the regions which are healthy, perspiration will frequently be found continuous and excessive, as if to compensate for the more general deficiency of the same secretion elsewhere; nor even in winter is it altogether deficient, particularly in such places as the palm and sole. I well remember a young lady, a private patient of Mr. Startin, in whom this disease was entirely confined to the

[1] Nayler, *On Diseases of the Skin*, p. 64.

palmar and plantar surfaces. Her father was similarly but less severely affected, while the rest of the family were quite exempt. Still more recently, an example of this rare affection came under my care at the hospital in a young woman, 20 years of age, who likewise had the complaint limited to the hands.

A case in private is now under my observation of an adult patient, who perspires everywhere except in the face, which is always dry, even in the heat of summer, but without any appearance of scales. Of his two children the younger, a boy aged 3 years, is an instance of general ichthyosis; while the other, also a boy, is entirely free.

From what has now been stated of ichthyosis, it will be seen that I have used the term in a far more comprehensive sense than has hitherto been assigned to it. Considered from this point of view, there are few cutaneous disorders which offer so many and at the same time such distinctive degrees of comparison. It varies from a general roughness of the surface, which may be scarcely perceptible, to a condition of the utmost severity, as in the harlequin fœtus; and between these two extremes every connecting link in the chain of development is complete. Whatever type the complaint originally assumes, its tendency is always to revert to that state, and most seldom to exceed it. We do not find, for example, the lower varieties of ichthyosis, however modified they may be by external causes, attain a higher or more advanced grade; nor, on the other hand, does partial ichthyosis pass into a more general form. I would also mention that scarcely a single case of ichthyosis has passed under my notice, unattended by a peculiar malformation of the external ear, and notably of its lobe, which might be taken as no mean exponent of the degree of the primary disease involving the skin. My attention was first directed to this inquiry when examining a harlequin fœtus, in which no trace of an external ear remained; and, in proceeding through successive deviations from this example, a corresponding diminution in the extent of malformation was observed, until the opposite limit was reached. The only apparent alteration then consisted in the lobe being connected with the adjoining surface of the cheek, of which it seemed to constitute a part.

Allusion has been already made to the complication of ichthyosis with prurigo; that with eczema will demand a few words. The occurrence of eczema, although sufficiently rare, is chiefly found in ichthyosis when the latter is partial. In some instances, the eczema, if slight, would seem to be accidental; but I am disposed to conclude that in the greater number the complication should be regarded as congenital, returning as it mostly does in the course of a few months from the date of the original disorder, and with an inclination to harass the patient more or less afterwards. At first, it is the face or scalp which commonly suffers, and then the complaint spreads to other parts, as the neighbourhood of the larger joints; and thus we find that, while the outer aspect of the extremities is uniformly rough and harsh, the inner surface is studded with eczematous patches. These vary in degree at different periods; but seldom, under the most favourable circumstances, is the skin wholly free. Sometimes the eczema developed in ichthyosis is due to syphilis, which may be delayed in its outward manifestation until the second or third year; later than this, no instance has come under my knowledge. Such cases are amongst the most severe in all that concerns the extent of the eruption and the attendant irritation. As a rule, they are unaccompanied by loss of flesh or syphilitic cachexia.

Among the occasional accessories of ichthyosis, for the name of complications they hardly deserve, may be mentioned an undue escape of the lacrymal secretion. This happens in those cases where, from the rigidity and consequent retraction of the skin of the cheek, the lower lid is everted. Another, and a more common attendant, inasmuch as it generally selects the milder examples, is the occurrence of coryza, and with it an inflamed condition of the Schneiderian membrane at its lower part. The coryza is often easily provoked, and may continue unchecked throughout the winter months. Again, the subjects of ichthyosis are more than others liable to bronchitis or catarrh, or they suffer habitually from cold to a far greater extent than ordinary persons. On the other hand, where no apparent outlet is afforded in any portion of the skin, the extreme of heat is still more dreaded in certain instances, although they

happily constitute a minority. It is not mere exposure to the sun's rays, or any kind of extraneous warmth, which awakens this burning sensation in the skin, once forcibly expressed to me by a patient upwards of seventy years of age, who had had general ichthyosis, I need not add, all her life, or nearly so. The heat of summer alone is enough to induce it.

There is a species of so-called ichthyosis to which the name of *spurious* has been given by some writers. It is a product of the sebaceous glands, and has no connection at all with the disease under review. In another kind, *ichthyosis cornea*—as remarkable as it is rare—I must refer the reader to what I have elsewhere mentioned on this subject. The name would seem to have originated from a tendency often noted in this disease to produce excrescences on various parts of the affected surface which, by their increase, become developed into horns.

The prognosis of ichthyosis, in its several varieties, is unfavourable as regards complete or permanent relief; but the complaint is nevertheless in most instances greatly amenable to treatment. After a time, the skin becames smooth, and scales are no longer renewed—a source of no slight satisfaction to the patient. The malformation, however, in any case remains; and with it a disposition to the return of the disease, which may be provoked by many causes, such as exposure to atmospheric changes, or the neglect of precautionary measures; and it is to the non-fulfilment of the required conditions, in so far as they relate to the general health and the state of the skin, that a relapse is mostly attributable. I have known ichthyosis successfully relieved, and to such a degree, by the warmth of summer alone, that during the season it could scarcely be said to exist; but, with the approach of winter, its true character never failed to be declared. In this class, which may be said to be restricted to the less serious cases, and only a particular section of them, there is no doubt that a removal to a more genial climate than our own would be followed, for the time at least, by a tolerable exemption to the patient from his complaint. I have now under observation, in the private practice of Mr. Startin, a boy aged 11 years, the subject of ichthyosis, who is a singular exception to a very general rule in this disease, inasmuch as in the summer months he derives the greatest benefit from a residence at the seaside, and even from bathing in the sea. The first example of ichthyosis recorded at the commencement of this paper is a notable instance of how much may be gained by remedial measures properly applied, the patient being enabled to return to her ordinary duties as a domestic servant with comparative comfort as regards the cutaneous disorder, thus kept in abeyance. In the milder cases, in which, although general, the limits of pityriasis are scarcely exceeded, much, and at the same time more lasting, benefit will likewise accrue from remedial agency; and the same applies with equal, if not greater force, to ichthyosis in its partial form. In that kind, which is distinguished by the extent and thinness of the scales, and where the surface partakes more or less of a reddish tinge, the probability of even marked improvement, in my experience, is remote. In these, the severity of the disease is less determined by the size and thickness of the cuticular products than by the general completeness of the complaint; and of this we have sufficient proof in the exposed mucous lining of the lower eyelids and the lips, as well as in the malformation of the external ear. There is also much liability to exacerbations and remissions, a sense of aching and burning generally preceding an attack. The fingers are then apt to contract in the flexed position, and likewise the elbows and the knees. As a consequence, transverse cracks speedily arise over the phalangeal articulations, or fissures form at the side of the elbow or the neck, or on the loins. While this condition lasts, the patient's distress may be imagined from the very helplessness it entails; and I am acquainted with such a case, in which, during an attack, the patient cannot move in bed or feed herself without assistance.

Treatment.—In the treatment of ichthyosis, local measures will be found of great service. Our first endeavour should be directed to get rid of the scales, and to render the skin as far as possible soft and supple. This is best accomplished by the aid of glycerine, a valuable agent in many diseases, as was first pointed out by Mr. Startin, who introduced it to the notice of the profession many years ago. Unlike

other greasy or fatty compounds, it is readily miscible with water; and hence its efficacy in removing, or at least in diminishing, the excessive dryness of the skin in ichthyosis. It may be turned to account in several ways. As a bath, in the proportion of six to eight ounces to thirty gallons of water, and at a temperature of 94 to 96 deg., it will prove most agreeable, and may be resorted to two or three times a week. Although it signifies little at what time of the day the bath is employed, I generally advise its use in the afternoon or at bedtime, as at the latter period it mostly secures a good night's rest; and in winter particularly, with proper precautions, the patient runs little risk of catching cold afterwards. The high price of glycerine is, however, often a bar to its use in this manner, from the frequency of repetition it entails; and it will then be enough for the patient, after taking an ordinary warm bath, to sponge the whole surface with a quart or more of warm water containing two or three ounces of glycerine; or he may use the latter undiluted, while the skin is still wet. This last is not only an economical mode of employing glycerine, but it is one of great service, as thereby much of its greasy character is lost, while the skin retains its pliability for several hours. In many cases, the bath is impracticable; in such, the patient should be told to grease the surface with an ointment containing camphor and glycerine—ten grains of one and sixty minims of the other to each ounce of lard. This is to be applied with a fold of flannel, and any excess removed by the same means. Sometimes, in lieu of an ointment, castor-oil is preferred; while any objection to its odour is readily obviated by the addition of a few drops of oil of bergamot or bitter almonds.

When the scales are very thick, and not readily removed with friction or soaking in warm water, a piece of pumice-stone will often assist in detaching them, or the use from time to time of glass cloth, such as is employed for polishing. The thickness is most marked in ichthyosis of the palms of the hands, or when it appears on the foot or around the heel.

As regards the general health, tonics, especially those containing steel, will be commonly indicated; and of these none are better than the sulphate and the perchloride. These it is, in most cases, advisable to combine with an aperient, from the tendency they naturally possess to produce constipation. The diet should be nutritive, consisting largely of animal food, and at the same time plain.

While the above remarks were passing through the press, an opportunity has been afforded me of observing a rare example of ichthyosis cornea. The affected surface comprised the greater part of the skin covering the right clavicle, the elbows, knees, and ankles; also the backs of the hands, including the digits. In these localities, the skin presented a smooth, almost glistening, appearance, and was, moreover, of a yellowish hue. It had lost its natural elasticity, and felt indurated to the touch, like a piece of cartilage, from the subcutaneous tissue being likewise involved, and adherent above. There was contraction, in the semiflexed position, of all the fingers—more evident on the right hand than the left, from its longer duration, and evidently produced by the same cause. A similar state existed on the toes.

The patient I refer to is under the care of Mr. Startin, whom she consulted for the first time, June 1870. Her age is 47. The catamenia ceased two years ago, when the above complaint commenced on the chest; and since then it has appeared in other and distant parts. There is no lack of perspiration generally; but she suffers much from exposure to cold, particularly in the extremities. Pain is felt chiefly over the knuckles and in the feet, especially along the plantar fascia; and so severe has it become of late as to occasion much difficulty in walking. There is no evidence of the affection being at all hereditary.

The extreme infrequency of this form of skin-disease, described by French writers as *sclerema*, must plead my excuse for thus placing it on record. So nearly does it correspond in many essential points to a similar case described by Willan in his work, page 209, that there is no difficulty in recognising it as an instance of what this close observer has been pleased to call ichthyosis cornea. In all that concerns, however, its more obvious characters, as well as in the free perspiration of the surface generally, and the development of the complaint at a so-called critical period of life, it is distinct from that class which, in its several grades, I have ventured to include under the common term ichthyosis. Indeed, its sole claim to the latter designation rests on the horny state of integument, which has already occasioned permanent flexure of the digits, and threatens, unless checked, to lead to more extensive results.

Order 8.—Tubercula.

Acne is generally described as an eruption of pimples or 'vari,' situated on the face, neck, or shoulders; very chronic in their course, and ending in resolution or imperfect suppuration. A more extended signification than this may, however, be given to it. Thus, it may imply simply an increased secretion of the sebaceous follicles, or their inflammation; or we may have, superadded to the ordinary eruption, a varicose condition of the cutaneous capillaries, with or without hypertrophy of the skin.

Acne commences at and after puberty, and rarely shows itself as a primary affection beyond middle age. It is one of the most frequent complaints incidental to the young adult of either sex. The peculiarity of the eruption; the state of the skin itself, which from the activity of the sebaceous glands often has a greasy aspect; the numerous black points at the extremities of the follicles; and lastly, its locality, render the diagnosis of acne in most cases an easy task.

The varieties of acne are the following:—acne simplex vel punctata, acne indurata, acne rosacea, acne sebacea, and acne syphilitica.

Acne simplex is distinguished by an eruption of pimples, varying in size from a pin's head to a pea, and scattered over the upper part of the body. In some cases it is limited to the face—the forehead, nose, and cheeks being mainly attacked; or it may at the same time appear on the sternum, or the shoulders, or between the scapulæ; and in the last situation, by no means an infrequent one, its existence is often not detected by the patient. The pimples are hard, shining, and red. They arise in successive groups, and each pursues for the most part an independent course. Often they may be felt as little knots or tubercles embedded in the skin, while the larger and more prominent are observed in various stages of development. Among some of the earlier pimples, after a few days, little yellow spots may be frequently seen at their summits, indicating matter beneath; but if this be let out, only a drop or two of pus escapes, and the size of the pimple is scarcely diminished. It retains for a considerable time its hard circumference or base, and changing in some cases to a darker colour, as in acne indurata, slowly disappears. Many of the pimples do not suppurate at all, and in others the pustular stage is delayed for several weeks.

Interspersed with the eruption just described, and indeed noticeable in most of the varieties of acne, may be seen numerous black points or specks. These are the apertures of the sebaceous follicles, loaded with secretion, and rendered black from exposure to the air. Besides occupying some portion of the face, or shoulders, they may be frequently observed in the external ear, and as a rule are hardly raised above the level of the skin. Popularly denominated 'grubs,' they can generally be dislodged by the aid of slight pressure applied to the margin of the speck, when a cylindrical mass is squeezed out, composed chiefly of sebaceous matter, besides containing in many instances a minute parasite, the *acarus folliculorum*. It is not uncommon for two or more follicles to inflame and unite, and so produce a good-sized pustule; or the same may occur to a single follicle. These changes are often noticed in the course of the disease, even when advanced towards recovery; and should the complaint be severe, small boils will sometimes be found in adjacent portions of the skin.

In *acne indurata* all the above symptoms are aggravated, and the disease is moreover distinguished by an indurated state of the pimples, and their confluence in lines or furrows. It is usually declared at a later age than the preceding variety, and is most frequent between the twentieth and thirtieth year. In its progress it is remarkably slow, and oftentimes occasions great disfigurement, which is apt to be increased by the accession of furunculi. The latter are less prone to suppurate than in other kinds of acne, and are commonly oval in shape, and of a reddish colour; that these contain pus we have sufficient evidence by the thick and yellow secretion which escapes when a puncture is made into the swelling. As recovery ensues, the apertures of the follicles long remain distinct enough to be plainly visible, while the pimples retain a livid or purple base.

Acne rosacea is more allied to erythema, and differs in many respects from the former varieties. When witnessed in early life or at puberty—not that it is commonly a disease of early life—it is sometimes severe, involving the greater part of the face, to which it is always confined. At this age, and particularly when occurring in the male, it is often hereditary. In the great majority of instances, acne rosacea is an affection of middle life, and in women is frequently worse just before the catamenia. The redness, from which its name is derived, is at first perceived only after meals, and limited to a small patch, usually seated on the nose or cheek; by degrees it becomes permanent. It is less observable in the morning, but assumes a brighter tint towards evening, and is increased by hot drinks, as tea or spirituous liquors, or by excitement or exposure, especially if the patient should afterwards enter a heated room, or approach the fire. Pimples, around the base of which the colour is always intensified, spring up, indolent in their nature, and tedious in attaining maturity; sometimes at the summit of these a yellow spot is seen, denoting suppuration beneath; or small blind boils become visible, particularly on the cheeks or chin. In many cases, and the more so as age advances, numerous dilated capillaries are seen in or just beneath the skin, arborescent on the cheek, while on the nose they are often longitudinal in direction. The complaint after a time loses its transitory character, and, peculiarly liable as it is to relapse, becomes confirmed. The skin no longer glides beneath the finger, but with the subcutaneous tissue becomes hard and thickened, and finally that hypertrophied condition is beheld which betrays the disease in its ultimate stage.

Acne rosacea is sometimes due to syphilis. It is then noticeable for the crimson flush, which commonly forms a continuous patch extending over the greater portion of the nose as well as the adjoining surface of the face. Developed upon it are small red tubercles, shining and semi-elastic to the touch; they are chiefly situated on the lower end or towards the side of the nose, and also on the cheek; when on the decline the redness vanishes, and although the tubercles may be scarcely recognised, their remains can still be plainly felt with the finger. The affected part is in no degree painful. It lacks the burning or smarting feel which so often attends acne rosacea. In other cases syphilitic acne has no fixed seat of election. When the pimples around it suppurate, small brown scabs are formed, and a minute ulcer is left at the apex. After this has healed, a depressed and circular cicatrix is left, around which a darkened or copper-coloured areola lingers for a long time. Another symptom indicative of syphilis is the absence of that oily secretion which is so general an accompaniment of acne.

Acne sebacea, although described in detail by most foreign authors, is sparingly alluded to by our own. I shall principally follow Hardy in his account of this affection, which, rare in this country, first attracted the notice of Biett. It is described as occurring in three forms—acne sébacée fluente, concrète, and cornée. In the first of these, the sebaceous matter is in a fluid state, and constitutes an unctuous covering on the surface of the skin. The secretion is unattended by pain or itching, and is often abundant. It occupies the same situation as the other varieties of acne, and is generally intermingled with them. In the second, the fluid concretes into a scab, varying in extent, sometimes occupying a large space, and in colour ranging from a light to the darkest hue. In consistence the scab is soft and easily moulded, and in recent cases removed with ease. Although similar in locality to the preceding, it sometimes appears on the scalp, and Rayer relates a case of acne sebacea of the scrotum. The last, or the acne sébacée cornée, is identical with the ordinary sebaceous tumours. (Hardy, *Maladies de la Peau*, folio 100; 1858.)

Various opinions have been expressed with regard to the causes of acne. The subjects of it, if young, are in otherwise good health. Unripe fruit, or great indulgence in beer or spirits, or insufficient diet, will produce it; and in girls it is commonly associated with irregularity of the menses; venereal excesses may give rise to it, and there is little doubt that some of the worst instances of acne indurata are occasioned by masturbation. Acne rosacea is sometimes hereditary, and in those who are thus by nature predisposed, the disease is readily induced by any

excess at the table, or even exposure to cold and wind; or it may be derived from artificial heat, as in cooks, smiths, and that numerous class who are constantly exposed to vicissitudes of temperature. The origin of the term 'rosacea' might almost seem to imply its limitation to those accustomed to deep potations of wine or other fermented drinks. But the complaint has no such exclusive restrictions, and even the most temperate are not exempt from it. Acne rosacea is apt to occur in women, when the catamenia are about finally to cease, as also in persons who suffer from hæmorrhoids or chronic disease of the liver. There is an eruption that I may refer to, which is sometimes produced by the bromide of potassium, taken internally and in large doses. Although it might be mistaken for acne, it more approaches impetigo sparsa, in its pustular character and occasional development on the scalp. It is a rare complaint, and one *sui generis*, as strictly speaking it exactly resembles no other form of cutaneous disease.

With respect to recovery, much will depend upon the duration of the complaint, and in no case should the patient be led to expect a rapid improvement. In acne indurata of a severe kind, a long period will sometimes elapse before any decided benefit is gained, and the same applies to acne simplex or punctata. Still, in any of these forms, as well as in acne rosacea, unless the latter possesses an hereditary tendency, a favourable issue may be anticipated.

Treatment.—In considering the different agents for the treatment of acne, we must be guided by its cause, continuance, and variety; and where there is sufficient reason to attribute it to any error in diet, or to amenorrhœa or other influences, the general state of the health should be regulated accordingly. The diet should be strict, and beer, or acid fruits, or salads especially avoided. If the long accustomed stimulus of alcohol has been suddenly withdrawn, it will be advisable to return to it in moderate quantity. The internal exhibition of steel and the addition of a purgative will commonly fulfil the requirements demanded by general treatment. Arsenic is seldom necessary in acne punctata or indurata, and not at any time in the other forms.

Local measures play no unimportant part in the treatment of acne; but care is required that they be not too stimulating. A lotion containing from two to four grains of the bichloride of mercury to eight ounces of rose-water, with the addition of half an ounce of rectified spirit, will prove useful; it is improved by the addition of half a drachm of dilute nitric acid. Sulphur is also serviceable in acne, and may be used in several ways; employed in a lotion it should be largely diluted. In other cases a lotion of bismuth answers extremely well in combination with mercury; one drachm of the trisnitrate, five grains of the bichloride, a drachm of spirit of camphor and eight ounces of water. Among ointments I may mention those composed of mercury or sulphur, which are to be lightly smeared over the parts once in twenty-four hours, and that at night before the patient retires to bed.

Before applying any of the above preparations, the patient should make use of a rough towel dipped in water as hot as can be borne, and thus by opening the pores of the skin cleanse the surface of any sebaceous matter that may have collected. In acne punctata he would also do well to rid the sebaceous follicles of their overcharged contents by making pressure at their sides with the finger-nail, when a little cylindrical yellow mass will escape. Any small pimples already on the verge of suppuration should be opened with the point of a lancet, or if of larger size, touched with the acid nitrate of mercury. To remove or diminish the increased capillary secretion, when this exists in a marked degree, various means have been devised. Among the best is strong nitric acid, painted over the part with a fine glass brush, and then immediately absorbed by blotting-paper. In the course of a few days the capillary vessels will be seen to be considerably diminished in number as well as in size. A repetition of the same acid may be employed to any spot that has not already showed signs of disappearing. When acne invades the chin, the latter is apt to become sore and painful. Neligan suggests in lieu of soap for those who shave, a saturated solution of the bicarbonate of soda, and an equal quantity of olive oil.—G. N.

Molluscum is characterised by round elevations, varying in size from a hempseed to a large currant or a hazel-nut, with a dark point and a depression on the summit of each. They have rather a translucent appearance; the colour of the skin over them is either normal or pinkish; occasionally there is a slight lobulation in them, visible through the skin. Some of the growths have no central depression and no black point. Some have a broad base (m. sessile), whilst others have a peduncle (m. pendulum). The skin over them is usually tense; it is occasionally wrinkled. These tumours either increase slowly in size, without any other change, or they ulcerate on the surface and their contents escape, or they inflame and slough *en masse*. They have been commonly believed to be sebaceous glands hypertrophied and altered. Some of them contain a white waxy or semi-fluid material, and a cyst which in some cases consists of several sacculi opening into a common cavity. Under the microscope are seen oil-globules and epidermal cells filled with granular matter. Others are more fibrous in structure. Dr. Beale [1] considers molluscum due to an alteration of the structures concerned in the formation of the hair, especially of the cells at the bottom of the follicle and the follicle itself, with hypertrophy of the subcutaneous areolar tissue.

Dr. G. Simon [2] describes two forms of the disease; one, which he calls molluscum simplex, he describes as due to an extra formation of connective tissue without any change in the hair-follicles or sebaceous glands; and the other, which he calls m. contagiosum, he regards as due to hypertrophy of the sebaceous glands.

It seems probable that there are two distinct diseases (both called molluscum) which present very similar naked-eye appearances, but are anatomically quite different.

Bateman, Cazenave, and others, used the term molluscum contagiosum; but most recent observers do not believe in the contagious character, and drop the epithet 'contagiosum.' M. Hardy states that he had not believed in the contagiousness of the disease till within the last few years, during which he has seen instances of what seemed to be evidence that it could be thus propagated. He thinks that this property is to be explained by the presence of branched tubes containing the spores of a cryptogamic plant, which he believes are constantly to be found in the tumours of molluscum. Professor Hebra, on the other hand, has tried to propagate the disease by rubbing the contents of the tumours on different parts of the skin without any result. The usual seats of molluscum are the trunk (either back or front), the neck, face, and scrotum. It is not attended with any constitutional disturbance. It may exist at any age, but is most commonly met with in children.

Treatment.—This is purely local. The tumours may be laid open, and the interior rubbed with lunar caustic. If attached by a pedicle, they should be snipped off and the base cauterised.

T. H.

Lupus.—The chief characteristic of lupus is its devastating tendency. Wherever situated, the skin is there destroyed, and finally replaced by a permanent cicatrix. It is, however, by no means limited in its ravages to the skin; sometimes it occasions an utter obliteration of the features; in other cases it ends in a loss of cartilage; and in more rare instances of bone. Generally of tubercular origin, it may be succeeded by ulceration of a most active or else of a most indolent kind; or, again, no ulceration whatever may be observed throughout. Never contagious, and seldom hereditary; situated commonly on the face; disposed to bleed from slight causes, and almost always aggravated by exposure; lupus, from its diversity, is not easily described in exact terms. Lupus may be said to admit of the following divisions: Tubercular lupus, strumous lupus, exedent lupus, syphilitic lupus, impetiginous lupus, and erythematous lupus.

Tubercular lupus is strictly a disease commencing in early life, for the most part

[1] *Path. Soc. Trans.* vol. vi. p. 313.
[2] *Die Hautkrankheiten, &c.* Berlin, 1851, pp. 235, 354.

appearing between the ages of two years and seven, and seldom primarily developed beyond the period of puberty. The affection is usually represented by a number of distinct tubercles, forming an isolated patch, and disposed on some part of the face, as the cheek or nose. The tubercles are of a reddish hue, slightly flattened at their summits, and in size ranging from a rape seed to a split pea. Their colour is modified by circumstances, and although at times pale, it is generally heightened by such agents as mental excitement or the warmth of a heated room. Beginning as a tubercle, frequently no larger than a pin's head, the complaint may remain stationary for months, ere it exhibits any signs of increase. At length enlarging at its circumference, it presents an irregularly flattened surface, slightly elastic to the touch, of a dull or imperfectly red colour; and bounded by a well-defined margin, which in the direction of its growth is studded with smaller and similar deposits. Sometimes crusts, not unlike those of eczema, may be observed upon it, which if forcibly removed are followed by bleeding, and even by ulceration, or the same result may happen from a blow; but if undisturbed, ulceration does not occur. In other instances, scales rather than crusts are formed of the thinness of tissue-paper, adherent in their centre, and curled and white at their edges. Under treatment the tubercles disappear by interstitial absorption rather than by ulceration, and leave in their room small white and indelible cicatrices. Sometimes the patch, level and of a whitish hue in the middle, shows at its border a number of irregular tubercles; or its whole surface is preternaturally smooth, mottled, and dotted with tortuous capillaries. Seldom at any time of its career is tubercular lupus attended by pain. It is a source rather of discomfort than of distress to the patient, whose health continues unaffected. Associated in a slight majority of cases with struma, as proved on inquiry into the history, although not often evincing any of its external signs, tubercular lupus exhibits a slowness in its progress unequalled by any other variety; and it is not infrequent to find the disease, originating as just described, after the lapse of twenty years and more, not exceeding in diameter that of a crown piece.

Commencing like a small boil, *strumous lupus* is distinguished by a tendency to pass into a state of superficial ulceration, unaccompanied mostly by pain. The sore thus established does not easily close. Sometimes it is all but healed when ulceration breaks out afresh, and the same process is repeated again. It is not so destructive as the exedent variety, and pursues its serpiginous course with slight progress for years. When a part has healed for a considerable time, the central portion will in many cases be smooth and dull white, firm, and quite devoid of all natural resiliency. In other cases, the greater part of the surface appears more or less glazed, with a few thin yellow crusts upon it, concealing a number of small and superficial ulcers; or the disease, soon after its origin, may lie dormant for a long interval, and then give rise to a circumscribed sore covered with a scab. Such is the varied course which strumous lupus may assume. When seated on the cheek, which it is in most cases, eversion of the lower lid sometimes takes place from the contraction of the cicatrices, and exposes the mucous membrane of the conjunctiva; and hence a constant overflow of its secretion, to the annoyance of the patient; or beginning on one cheek, the complaint may pass ribbon-like beneath the lower jaw to a similar spot on the other side. Another situation not very uncommon for strumous lupus is the back of the hand or the forefinger; and it is more usual on the upper than the lower extremity.

The *exedent* is the most frequent variety of lupus. Taking rise as a small hard tubercle, it merges after a variable period into the suppurative stage, and becomes covered with a scab. The disease may be circumscribed and limited to a single spot. More commonly other tubercles appear in the immediate vicinity, which pass through a similar stage to the first. When situated on the nose, for which *lupus exedens* seems to have a special predilection, a number of crusts may generally be seen to involve its lower part, adherent and of a greenish-yellow tinge. Should they be removed, a thin light yellow fluid may cover an excavated ulcer: or in place of any secretion, a red granular surface only is left, which bleeds on the least pressure. So soft indeed is the part, that several of the granulations are often

entangled between the blades of the forceps employed to detach the scab. Lupus exedens sometimes attacks the nose from within; its mucous membrane first becomes increased in vascularity as well as swollen at a certain spot, and a small crust is established, which in most cases is picked off by the patient. Ulceration still goes on beneath a new crust, and at length perforation takes place, should the septum be the seat. Lupus exedens may exist in other parts at the same time, as on the neck, or little toe, or on one of the fingers, proceeding in its course to the complete destruction of the latter; or it may spread over the whole face and scalp. Sometimes no pain of any kind is experienced; occasionally a sense of itching is felt, worse towards night and generally after meals, or only after certain articles of food have been taken. The disease is almost invariably increased by exposure to cold and wind, and often aggravated at the catamenial period. The consequences of lupus exedens vary with its situation and the stage at which it has yielded to remedies. Thus, if treated at an early period, as when on the nose, no visible alteration may remain beyond a slightly indented scar; or in a stage removed from this, the end of the nose may be pointed and irregular; or should the cartilage be destroyed, a smooth and polished appearance is given to that portion which remains. On the cheek, the resulting scar if small in its outline is sometimes of a colour inclining to purple; but when more extensive or in other parts, the cicatrices constitute white and thickened bands similar to those produced by a burn. When the disease encircles the mouth or one or both of the nasal apertures, they sometimes become contracted as cicatrisation ensues. Lupus exedens may occur on the upper lip immediately below the septum of he nose, the cartilage of which, as well as the lateral cartilages themselves, soon become involved in one common destruction.

Syphilitic lupus is sometimes manifested by the effects of constitutional syphilis being superadded to the ordinary signs of lupus, particularly of the strumous and exedent varieties. Seldom can any reliable conclusions be drawn from the patient's history. Its situation and its multiplicity should be taken into account. Thus it may attack the forehead or the bridge of the nose, and invade at the same time a great part of the upper extremity. I have seen it occasionally attack the buttocks: a serpiginous or horseshoe form is very characteristic of a syphilitic taint. Sometimes we observe one or several patches on various parts of the body, having a smooth centre but a raised and rugged margin, partially covered with crusts and much inclined to bleed. These patches are not uncommon on the forearm near the wrist; a case in a child of about 8 years of age was under my care at the Hospital, in which the complaint was situated on the calf of the leg. In another and opposite kind, but not the less syphilitic, the disease destroyed the lower part of the nose in a young woman, and the margins were surrounded with dense and quickly-growing tubercles. It is not necessary that the complaint be severe in order to be syphilitic, but it may nevertheless owe its severity to such constitutional taint. The worst case of the kind which has occurred to me was that of a boy aged 13 years, an outpatient of the Hospital, who had been suffering from this complaint ever since he was three years old. The nose became quite destroyed, and the mouth reduced to an aperture scarcely large enough to admit the finger. None but those about him could understand his altered articulation. The teeth were nearly all destroyed, and at a subsequent period he lost his left eye.

Impetiginous or papulo-pustular lupus is a name applied by Mr. Startin to that species of lupus the external characters of which resemble those of impetigo. The disease mostly occupies a considerable portion of the face, either as one large and irregular patch or else subdivided into smaller groups. In any case the suppuration is abundant, and the crusts are yellow and easily separated. The latter are neither curled at their circumference, like those of eczema, nor yet raised, as in porrigo: and if removed are quickly renewed. When the scabs are circumscribed, the surrounding skin is often inflamed, but it still retains its natural elasticity. Impetiginous lupus is often engrafted upon struma.

Among the more immediate causes of lupus, the receipt of some local injury is often assigned by the patient as the occasion of its first appearance, and hence its

origin is frequently attributed to a blow or scratch. Sometimes it is reported to have succeeded a severe fright, or other strong mental emotion.

Treatment.—In the local treatment of lupus exedens, when the part is covered as it usually is with a firmly adherent scab, the latter should be removed. In slight cases this is accomplished with a pair of ordinary dressing-forceps; but in the more severe, the scabs or crusts should be previously moistened with rags dipped in hot water, or with a poultice. To the surface now exposed we apply for a few seconds a little cotton or carded wool, to soak up any pus or blood; and as soon as it is thus cleansed, the part should be touched with the solid nitrate of silver, cut, if requisite, to a point; or else painted by means of a glass brush with the acid nitrate of mercury. Sometimes it is expedient to conceal the immediate effect produced by the acid, which is easily done by covering the surface with a piece of red blotting-paper, and then painting the latter with collodion. No interference is to be allowed with the eschar occasioned by the caustic. After it has come away, the surface should be wetted two or three times a day with a weak nitric acid lotion; if it still looks unhealthy, a second application of the acid nitrate of mercury will be required, and may be repeated at intervals of two or three weeks. In other cases, in which, as recovery ensues, a red and granulating surface is left, we may substitute with advantage carbolic acid in the form of a lotion, and this should be applied over the thin scales which have replaced the former scabs. In lupus exedens, and particularly if it be conjoined with struma, cod-liver oil will prove a valuable remedy. In what manner it is assisted by mercury is not clear, but given in combination with this mineral, as half a grain of calomel with opium every alternate night, or three times a week, its efficiency is much increased.

In tubercular lupus, the tubercles should, as in the exedent variety, be touched at their summits with a similar caustic. It matters little which is employed, the acid nitrate of mercury, or nitric acid, or caustic potash; but each should always be of the strongest kind, and never applied over too extensive a surface at one time. Tubercular lupus, as far as I have observed, admits of no other local treatment. The caustic requires to be repeated at intervals, until the tubercles are nearly reduced to the level of the skin; for if allowed to extend deeper, little excavations or pits remain, which should be avoided. The patient should be cautioned that considerable inflammation is apt to follow the use of the caustic agent, whatever it may be, and that three or four days or more will often elapse before it abates. As regards constitutional treatment, cod-liver oil and mercury may be given, as in the other forms.

Although by these means we shall succeed in reducing the tubercular mass to the lowest point of which it is capable, and sometimes to such a degree as to render what was before an unsightly object now scarcely perceptible, it should be remembered that the tubercles are very likely to form again, and this tendency must be accordingly corrected. In no kind of lupus is the tendency to recur more frequently shown than in the tubercular variety.

In strumous and in the papulo-pustular lupus, when the suppuration is free, and the ulceration superficial, an arsenic and calomel caustic [1] will be most useful. Sometimes in children this is too stimulating, and calomel alone is the better application. These cases are seldom able to bear the more severe caustics; they are more likely to improve, as well as the syphilitic lupus, should the ulcerated surface be extensive, by the application of a weak nitric acid lotion and the trisnitrate of bismuth.

Plastic operations for the restoration of the nose from lupus have been performed within the last few years by Mr. Hamilton, of Dublin. Time, however, furnishes the only safe ground on which to base our conclusions as to their success. Tried by this test the final issue, even in selected instances, has not been such as to lead me to anticipate a hopeful result from operative interference. In all cases of this kind we have diseased tissue to deal with, and hence sloughing of the part is a likely contingency—an event which mars the best operation; for unless union takes place by the

[1] It is made thus:—acidi arseniosi, gr. iij.; hydrargyri bisulphureti, gr. ij.; hydrargyri chloridi, ʒj. The powder is made into a paste with water, and applied with a camel-hair brush after the scab is removed.

first intention, the condition of the patient is rendered worse than before. Again, there is often great difficulty in forming a proper septum, which, should the disease return, is almost sure to be destroyed. But the strongest objection is to be found in the fact that the new structure has finally dwindled or degenerated, after apparent success has at first been gained.

Sometimes we are called upon to repair the ravages produced by destruction of tissue in the lips, over which the saliva is always dribbling. In such a case our first endeavours should be directed to promote cicatrisation, an obstacle to which is often to be found in an offending tooth. A well-marked case of this character was that of a man advanced in years, and who had long been an out-patient under Mr. Startin. After the surface had healed, an attempt was made to supply the deficiency of the lower lip, which was almost wholly destroyed, by an artificial one formed of gutta percha and afterwards stained of the natural colour of the skin. This was attached by either end to an elastic band, which passed round the back of the head and served to keep it in position. By the aid of this simple contrivance the patient could partake of his food with comparative comfort. He was also able to resume his work as a gardener, without being subjected to those personal annoyances which his former disfigurement frequently gave rise to.

The subject of *erythematous lupus* has received so little attention from writers on diseases of the skin, that I shall offer no apology for dwelling at greater length than usual on this not uncommon variety.

Erythematous lupus is not a complaint of childhood, and is extremely rare before puberty ; it pertains rather to middle life. The influence of sex is remarkable, and the frequency of its occurrence in the female in comparison with the male may not be unduly represented at eight or ten to one. Unlike other kinds of lupus, the erythematous is met in the higher equally as in the humbler ranks of society ; occupation, indeed, would seem to have little power in its primary manifestation, however it may affect the issue, as in those callings which demand continued exposure, whether to extreme heat or cold. Again, erythematous lupus is commonly associated with good health, and as an affection of the skin it occurs alone, being seldom attended or followed by any other cutaneous complaint. Lastly, the disease is in no degree hereditary, nor, I may add, contagious.

The earliest sign of the eruption is in general denoted by an erythematous patch on the face, usually the cheek, but it may be the nose or forehead, which, at first only temporary, becomes afterwards permanent. When the patient has what is called a high colour, the preliminary redness is sometimes scarcely noticed, while in an opposite class its occurrence is at once observed ; in many instances, before assuming a persistent character, it appears only at a particular time, as, for example, in the summer months, and again returns during a like period for two or more consecutive seasons. There are now developed, on or near the centre of the patch, small white scales, which increase in number until they approach its edge, where a clearly defined border is left. The scales occur in two forms, either as scurf or as a crust, but in either case they closely adhere to the surface.

The former of these varieties is the most frequent, and as a rule is accompanied by a sense of heat and itching in the part, particularly if the patient be exposed to a cold wind or the warmth of a fire. It terminates either in a white cicatrix, which as a rule is on a level throughout with the surrounding skin, destitute of scales, and devoid of any hardness ; or in complete recovery.

In the second variety the crust, as it may be truly styled from its thickness, is not detached without difficulty from the skin, and when removed, there are seen on its under or attached surface a number of minute projections which dip into the follicles of the cutis, and render more intimate the connection between the two. A further stage consists in the following curious condition, which the part thus affected undergoes. The crust has disappeared, and a peculiar mottling of the skin is left, which may be likened to the dotted surface of the cut rind of an orange or lemon. The period when this takes place varies in different cases : it may commence within

a few weeks of the outbreak of the complaint, or it may be deferred to a much later date. Let it happen when it may, this condition implies a structural change in the skin, which, in my experience, does not admit of a return to its normal state; it approximates to a cicatrix, and to this it at length tends, becoming with age smooth and white, but still elastic.

Although the above may be instanced as the usual types of erythematous lupus, departures from them nevertheless will happen. In some, the crust of which I have just spoken occurs by itself, with no erythematous base, and in this case the part attacked occupies but a limited space. In another class, the scales are so numerous and extensive as to well nigh conceal the patch on which they rest, and give to the complaint an appearance much resembling psoriasis. In a third kind, the disease is seen in a multiple form, and approaches more nearly to erythema with a sparing quantity of scales on its surface.

Besides the localities already named, the disease is sometimes declared on the eyebrows or the lids, and these may even furnish the only evidence of its existence. In the former it is for the most part speedily followed by a loss of hair on the patch, which is seldom, if ever, renewed; and in the latter it generally manifests itself as separate and circular spots, or it may attack either canthus, and thus involve both lids simultaneously. Sometimes along the line of the eyelashes, where the complaint encroaches on this part, a row of small scales will be seen to surround their roots; and in chronic cases, the mucous lining of the affected lid exhibits in one or more places a deeply red spot, while the rest of the same surface shows a brighter hue than natural, or by comparison with that of the other eye. As a sequence, an excess of the lacrymal secretion takes place, which is often the means of directing our attention to the condition of the lid, and so detecting the appearance it assumes. Should the complaint affect the ears, the lobes are commonly the first to suffer; from these it may creep along the whole rim, which in confirmed and chronic instances shows a singular departure from the state of health in the white, rough, and wrinkled, almost sodden appearance it presents. In others, the disease is mainly confined to the back of one or other of these organs, or the front of the concha, from whence it may travel along the external auditory canal, and interfere with the sense of hearing. Erythematous lupus is equally prone to attack the scalp, particularly in or near the middle line, where one or more patches may be observed destitute, as on the brow, of hair; and, if of long continuance, assuming a smooth and perfectly white aspect. Again, the exposed mucous surface of the lips offers another and not at all an infrequent locality; the complaint in this situation being conspicuous for the dry state of the membrane, which is rough from the presence of small and semi-adherent scales; or it may involve the mucous lining of the nostrils, commencing, as is usually the case, on the skin near the septum, and gradually spreading upwards.

Whatever its situation, the tendency of the disease is to spread, and this may take place in two ways, either by an extension of the patch at its periphery, or by the evolution of separate spots, mostly circular in form, in various places on the surface. As illustrating its general course, I would remark that where the cheek, for example, is the subject of this complaint, it mostly happens that sooner or later a similar patch arises on the other side, and these, enlarging at their circumference, approach one another, and spanning like an arch the bridge of the nose ultimately coalesce, forming a sort of mask which envelopes the greater portion of the face. In extreme cases, in which erythematous lupus has existed for many years, we may sometimes note at one and the same time, the various phases of development and decline. Not always, however, as if to demonstrate its uncertainty, is erythematous lupus thus progressive. Sometimes the complaint is confined to a solitary spot or patch, which for years makes little appreciable advance.

Although from the chronic nature of the complaint we cannot in severe examples predict the time when its progress will be stayed, or deny the possibility of a relapse, the disease, whatever its form, is largely determined in its course by the following events. In the first list may be ranked anything that depresses the mind, whether care, anxiety, or grief. In like manner exposure to a cold wind is sure to aggravate

the disease, and so will in many cases a too near approach to the heat of a furnace or a fire, or a protracted stay near the sea-coast; not seldom is erythematous lupus associated with leucorrhœa, or some uterine disturbance or ascarides or hæmorrhoids. Even a slight derangement of the general health or habitual costiveness or too much indulgence at the table will occasion a similar result. Some of the worst cases of this affection that have passed under my notice have occurred in those who have been obliged to work daily in the fields, besides subsisting on scanty fare. In these the chance of permanent improvement is slight as long as the above influences exist. In other cases, and particularly when the affection is seen in an early stage, a more fortunate issue may be anticipated. I have already alluded to a multiple form of erythematous lupus occurring on the face, and in this variety the prognosis is favourable.

Diagnosis.—Unlike most eruptions of the skin, it is in its early stage that the difficulty of diagnosis is usually greatest, although in many cases its true character has not been suspected at any time. Nor will this be altogether a matter of surprise, when the comparative rarity of the complaint is considered, or its varying aspect in the same patient, and still more in different instances. In the majority of its symptoms, the erythematous is wholly distinct from the other kinds of lupus, and at no period is it attended by that destruction of the soft tissues or of cartilage which gives to lupus in general its hideous aspect. From its restriction to the skin, and the occurrence of scales on the patches, erythematous lupus may be mistaken for psoriasis; for so abundant is the squamous covering in some cases, that an error on this point may be well imagined. On examination we shall discover that the scales are not accumulated towards the centre, that the progress of the patch, if a solitary one, is in general slow, and the redness remarkable for the abruptness of its margin. The scales are moreover so adherent, that friction fails to remove them. Among other aids to diagnosis may be added the development of the disease after puberty, and its limitation, except in a few instances, to some part of the face or scalp. Again, there are certain species of secondary syphilis, which bear a close similitude to erythematous lupus.

In the variety characterised by the peculiar mottling of the skin to which I have before adverted, a mistake in diagnosis is less likely to arise, and in all instances the co-existence of a similar complaint in such regions as the ears, scalp, or mucous membrane of the lips will be strongly corroborative of the diagnosis of erythematous lupus. Finally I may add that, when occurring only upon the cutaneous surface of the lids, or around the eye, it is frequently confounded with eczema; or if at the eyelashes, or the adjacent conjunctival lining, with tinea tarsi.

Treatment of erythematous lupus.—The use of the more powerful caustics is inadmissible in this form of lupus. Should the complaint have made little progress and present a good deal of redness, the patient may apply twice a day with advantage a weak solution of nitric acid. The benefit of this treatment is most apparent when much cuticular desquamation overspreads the patch. Or if smarting pain be felt in the evening, a lotion of borax, a drachm to eight ounces of water, with two drachms of dilute hydrocyanic acid, may be substituted. If the disease be very limited and as yet in an early stage, I have frequently found that blistering the part in the first instance is useful before having recourse to either of the above lotions. In some cases, as when the scales are unusually thick and removed with great difficulty, the arsenical powder applied over them has succeeded in rendering the surface smooth. Internally steel is recommended, to which in chronic cases arsenic may be added.

Cases are related of lupus ending in spontaneous discovery. This is contrary to all I have ever seen of the disease, which, left to itself, instead of inclining towards improvement, is distinguished by an opposite tendency. It may happen that for a while this affection may remain stationary, as in the tubercular form, but it is contrary to experience that the tubercles should of their own accord disappear; indeed, I would rather say, that the degree of relief to be expected or attained in lupus is proportioned to the period at which the remedy is applied, and not to any inherent property the disease possesses to become exhausted or to wither away.

The plan which is sometimes recommended, of treating the disease by constitutional measures alone, as cod-liver oil, and at others by local means only, can scarcely apply to a complaint which differs so much in its symptoms, progress, and issue, and whose course itself is so liable to vary. G. N.

Leprosy, tubercular leprosy, or *elephantiasis Græcorum.*—Without entering into any argument as to the identity of this disease with that so frequently mentioned in Holy Writ, or described from the earliest dawn of profane history as existing in Egypt, there can be no doubt that if we refer to the records of the fourteenth and fifteenth centuries of our own era, we shall find abundant evidence of its ravages over the greater part of the continent of Europe, and that the inhabitants of these islands were in no way exempt from it. Happily rare among us at the present time, the complaint nevertheless prevails to a great degree in Norway, Denmark, and Greece. In the East and West Indies, the Azores and Madeira Islands, and along the shores of the Mediterranean, it is not at all uncommon. For an interesting addition to our knowledge of leprosy we are indebted to a professional visit paid by Dr. Webster to the Hospital for Lepers at Granada, founded by Isabella, and supported to this day by the Spanish Government. The results of his inquiries are embodied in a paper which was read before the Medico-Chirurgical Society in 1854, and to the facts therein contained I shall have occasion to allude.

Leprosy is much more common in the male than the female. Of 284 lepers who were reported in Spain in 1851, 188 were of the former and 96 of the latter sex; and at the period of Dr. Webster's visit the ratio between the sexes was thirty-five to fourteen. The experience of Mr. Day confirms this statement as regards the greater prevalence of this affection in the male among the natives of Madras. In Bombay, at the Jamsetjee Jeejeebhoy Hospital, where all classes of natives are admitted, the proportion is still higher than the preceding. In this latter Presidency the disease is well known among the natives; it is not restricted to caste, but affects the Anglo-Indian, Portuguese, Parsee, Jew, Mussulman, and Hindoo. Although comprising two varieties, the tubercular and the anæsthetic, it must be understood that these are frequently united in the same person, and that the latter is often found to merge into the former variety of the disease.

Elephantiasis is comparatively rare under puberty, and it does not often occur after middle life. Its effect in shortening life is variously stated by different authorities. Although it may show itself at any age, yet when it happens before puberty, the general signs indicative of puberty are deferred beyond the usual time; the hair becomes scanty and ill-formed, and the whole frame ill-developed. Moreover, when it appears at this period of life the patient seldom survives beyond a few years.

Anæsthetic leprosy occurs in patches, and is characterised by a want of sensibility in certain parts of the skin. The patches are circular, or serpiginous; sometimes little elevated above the surface; and in size ranging from a threepenny to a crown piece. In colour they may be almost white or reddish, and at the margin of a light brown. They are found on any part of the trunk or extremities; or on the face, as the forehead, cheeks, or lobes of the ears. Sometimes the patches coalesce, in which case a large extent of surface is occupied by the discoloration. It is in their centre that anæsthesia is most marked: not that this sign is confined to the patches; it may extend along the greater part of the trunk or limbs, following the course of one or more of the nerves. The diseased surface is generally dry and wrinkled, mostly destitute of hair, and devoid of moisture. Sometimes the skin of the fingers or toes is shrivelled and covered with exfoliation of the cuticle. In a few instances a pricking pain is first felt, and in some an eruption of vesicles or bullæ is among the earliest symptoms. These soon burst and form ill-conditioned ulcers, which are slow to heal, and secrete an offensive sanies. After the discharge is reduced, the ulcer, although not extending at its circumference, increases in depth, reaching to or exposing the bones. The phalanges of the fingers or toes are in this way attacked, and become attenuated in their centre. Supposing one of the hands to be affected, the patient

loses power over the extensor muscles, the hand drops, and he is unable to straighten it. Although it may extend to the trunk, anæsthetic leprosy does not often commence in this region. It generally proves fatal through the supervention of some exhausting disease, as dysentery or diarrhœa.

Tubercular leprosy is preceded by a variety of symptoms. Sometimes the first thing that attracts the notice of the patient is a numbing pain in the part, or there may be only œdema. More commonly irregular patches are observed, slightly elevated, and of a grey or brownish colour. On these patches are developed small tubercles, which are usually of a red hue. With their multiplication and increase on the face the countenance becomes greatly disfigured. They are often collected near the apertures of the nostrils; or on the upper lip; or on the forehead, which is thrown into large folds; or they may commence on the lobes of the ears. The occurrence of febrile paroxysms is noticed by some authors, during which the local symptoms are aggravated. With their disappearance, and they generally last about three days, the patient feels little uneasiness, and sometimes the blotches disappear. This condition, however, is only temporary, as sooner or later the blotches return. After a time other complications arise, which involve one or more of the organs of sense. The tongue or the soft palate is covered with similar tubercles, which, as they ulcerate, produce a fœtid discharge. As the tongue participates, all appreciation of taste is lost, deglutition is with difficulty performed, and the voice has a harsh sound, or is scarcely audible. If the disease spreads to the vocal cords, or the trachea, the patient dies from suffocation. When the nose is implicated, fragments of diseased bone are often intermingled with the pus. Sometimes ophthalmia is induced, which is generally the forerunner of further and destructive changes taking place in the eye.

A difference of opinion exists as to the influence of leprosy on the generative organs. Most modern authors reject the testimony of antiquity on this point, and regard as fabulous the *libido inexplicabilis* recorded by older writers. Dr. Webster confirms the judgment of the latter, relying on the statement of Dr. Alveiro, who for many years filled the post of Superintendent of the Leper Hospital. Whatever may be the effect at an early stage, there is reason to believe that with the progress of the disease atrophy of the testis is far from being an infrequent result.

As to the causes of leprosy, little is known that can be urged with certainty. In the fertile districts around Granada, which teem with an agricultural population, provided with the ordinary requirements of life, the complaint is rare; indeed, it is mostly limited to the sea-coast. The same may be said of its appearance in France, where it is chiefly seen in the southern provinces of the empire. It is uninfluenced by occupation. However free from it the pure English race may be in India, it will attack those of mixed descent in that country and in the West Indies. I am credibly informed that it is not uncommon in the white population who have long resided in the latter colony. In India it is chiefly confined to the poorer classes of the community, but the rich do not always escape. A diet consisting mostly of fish is supposed to be favourable to its development; the disease is nevertheless frequently met with inland, as in the Deccan and the North-West Provinces.

With respect to hereditary transmission, there is no doubt that elephantiasis is sometimes received in this way, more often than the subjects of it are able or willing to admit. As in other hereditary complaints, elephantiasis occasionally passes over one generation to reappear in the next. It is never contagious. It is not known to extend to those whose duty it is to wait on the sick, or who are otherwise brought into personal contact with them. A leper may continue to live with his family for years, without communicating the disease to any of them; nor is he considered an outcast so long as he can toil for his bread, or has the means of supporting himself. It is when his resources at length fail, and he is obliged to beg in the bazaars, maimed and mutilated, that he becomes an outcast in reality, and presents a pictureof misery to which it would be difficult to furnish a parallel.

Much of the obscurity that long enveloped the morbid anatomy of leprosy has

been dispelled by the valuable investigations of Dr. Carter,[1] who, as surgeon to and curator of the Museum of the Jamsetjee Jeejeebhoy Hospital, has had ample opportunities of pursuing his inquiries. The conclusions he has arrived at throw an entirely new light on this important point. It is in the altered conditions of the nerves that we must really look for the seat of mischief. To the eye the affected nerve is considerably enlarged, and changed in colour to a reddish grey. On section its funiculi are remarkably firm, but the neurilemma is unaltered. Microscopical examination shows the nerve tubules at the seat of the enlargement to be more or less wasted and atrophied, and accompanied by fatty degeneration. The places at which these characters are seen vary with the nature of the nerve. Another result of the same disease may be mentioned in reference to the bones, as the digits, which after a time undergo remarkable changes, due to interstitial absorption and necrosis. The fingers and toes are sometimes reduced to so many stumps, and in every case the last phalanx is the first to suffer. The bones themselves become likewise lighter and thinner.

Treatment.—Little can be done in the way of treatment. In an early stage, before the tubercles have ulcerated, the complaint is in some cases arrested for a time by the internal administration of mercury, given in a decoction of bark or some other vegetable tonic. The prognosis, however, in any case is very unfavourable.

Elephantiasis Arabum, sometimes styled Cochin or Barbadoes leg, has its seat mainly in the extremities or the genital organs. It has never been a conspicuous disease in Europe. Although its derivation would seem to imply an Arab origin, the complaint is less frequent at the present day in Arabia than in certain parts of India, as the lower provinces of Bengal, and particularly along the coast of Malabar.

So prevalent is elephantiasis Arabum in British Cochin, that Mr. Day,[2] who for some time filled the office of civil surgeon there, records his inquiries thus :—

In 24 Indo-European families, 1 in $18\frac{3}{4}$ affected.
In 71 Native Christian „ 1 in $17\frac{1}{11}$ „

According to Mr. Waring,[3] the Jews (white and black) in the same locality exhibit a higher proportion, being in the ratio of 1 to $14\frac{1}{2}$ nearly. Besides these classes, elephantiasis attacks, and that indiscriminately, other of the native races of India, as the Mussulman and Hindoo.

In 100 cases, Mr. Day reports as follows :—

	Males	Females	Total
Left forearm	3	0	3
Right lower extremity	17	10	27
Left „	11	13	24
Both extremities	18	13	31
Both lower and upper extremities	4	0	4
„ right upper extremity	1	0	1
„ left „	2	0	2
Both lower extremities and scrotum	1	0	1
Left extremity and scrotum	1	0	1
Right „ „	2	0	2
Scrotum	3	0	3
Mammæ	0	1	1
	63	37	100

From this table it appears that no less than 93 cases of elephantiasis in 100 are those affecting the lower extremity. A smaller percentage is given by Mr. Waring; thus, in a collection which he made of 945 cases, 307, or 32·49 per cent., belonged to the lower extremity; 287, or 30·57 per cent., to the upper extremity; and 344, or 36·40, to both lower extremities.

Under the age of ten years, elephantiasis Arabum is infrequent. From the period of puberty to the age of twenty-five or thirty years it is generally observed. Owing to the prejudices of caste, it is difficult in India to determine anything like an exact

[1] *Transactions of the Medical and Physical Society of Bombay*, vol. viii., new series, p. 1.
[2] *Madras Quarterly Journal of Medical Science*, 1860, p. 37.
[3] Waring, 'On Elephantiasis,' *Indian Annals.*

ratio of its occurrence between the two sexes. There is little doubt that it is more common in the male than in the female, and probably the proportion of 2 to 1 would represent the nearest approximation. It is not a little remarkable, that while in Madras elephantiasis so much affects the lower extremity, in Calcutta it is the genital organs which are usually attacked. Sometimes the complaint undergoes a kind of metastasis, and leaves the leg altogether, only to show itself in the scrotum or other parts.

[Elephantiasis for the most part commences with erysipelatoid inflammation, attended with febrile symptoms. The parts affected become red and deeply infiltrated; and at the same time the superficial veins and lymphatics generally form red, painful indurated cords, and the corresponding lymphatic glands become inflamed. The tissues at this time are infiltrated with yellowish transparent coagulable fluid, apparently lymph. The inflammation lasts for a few days, and on subsiding leaves more or less swelling and induration behind. Subsequent inflammatory attacks recur from time to time, each one adding to the permanent hypertrophy which is in progress. Thus by degrees the affected parts become largely, sometimes enormously, increased in bulk and altered in aspect. The hypertrophic changes may, however, originate and progress independently of obvious inflammation.

In some cases elephantiasis involves mainly the skin and subcutaneous connective tissue; in some it includes the whole of the connective tissue between the skin and bones. In either case, but chiefly in the former, the skin often undergoes much change of texture and appearance; sometimes it becomes coarsely papular or warty, sometimes studded with nodular elevations, sometimes ulcerated; and the epidermis, though often remaining normal, may desquamate or get thick or horny, or take on the characters of ichthyosis, or become more or less deeply coloured from deposit of pigment granules in the rete mucosum. The surface, moreover, may be anæmic, congested, or livid. When the disease extends deeply, fat, muscles and nerves get compressed and waste; but the bones undergo hypertrophy, new layers and irregular outgrowths forming, and adjoining bones occasionally becoming organically united.

Elephantiasis appears to consist primarily in an inflammatory hyperplasia of the cellular elements of the connective tissue, in connection with which (according to Virchow) there is reason to believe that the roots of the lymphatic vessels are specially involved. Inflammatory overgrowth of the elements of the lymphatic glands next ensues, with obstruction to the passage of lymph through them. Then this fluid stagnates in the lymphatic vessels, which sometimes dilate even to their radicles in the cutaneous papillæ, and accumulates in the interstices of the affected tissues, adding to their bulk, and at the same time stimulating them to overgrowth. It is only in the early stage of the disease that the dilated condition of the lymphatics admits of ready detection. At a late period the morbid tissues are characterised mainly by a dense accumulation of white fibrous tissue. The lymphatic glands also after a time become the seat of fibroid change.

In some cases of elephantiasis, especially those in which the genital organs or adjoining parts of the thigh or abdomen are implicated, groups of vesicles appear here and there on the affected surface, which are really dilated lymphatic spaces, and which on rupturing (as they are apt to do from time to time) discharge considerable quantities (sometimes several pints at a time) of lymph, which coagulates after its escape, and is either yellowish and transparent, or milky from the presence of molecular fat. There is reason to believe that chyluria is due to a similar affection of the urinary passages; and indeed this is occasionally associated with elephantiasis.

Dr. Lewis's observations, which have been confirmed by many subsequent observers, show that, at any rate in a large proportion of cases of elephantiasis, as well as of cases of chyluria, the blood contains large numbers of embryonic næmatoid worms, to which he has given the name of filaria sanguinis hominis. And it would further seem that the presence of filariæ in the blood is due to the presence of one or more parent worms, two or three inches long, lodged somewhere in the body, probably in some part of the hypertrophied tissues. It is supposed that in those cases in which the

filariæ are present they are the cause of the patient's malady, and that they produce mischief mainly by obstructing the lymphatic channels.

The regions most frequently attacked with elephantiasis are the lower extremities and genital organs. But other parts may become affected, and especially the female breast. In the first of these cases the disease usually begins in the toes or about the ankles, and gradually involves the whole leg up to the knee. It rarely, however, rises above this point. J. S. B.]

The swollen limb is hard and brawny to the touch, and little capable of impression; and is often covered with thick cuticular exfoliations, resembling those of ichthyosis, which decrease in number and size from below upwards. In this state it may remain for years, causing little pain, and inconvenient only from its bulk.

The further progress of the complaint is frequently proportioned to the fatigue the patient has to encounter. As long as the limb is allowed to remain quiet and horizontal in position the increase is inconsiderable, but continued exertion, as standing, aggravates the local symptoms, and the pain, at first intermittent, becomes constant. The limb is greatly enlarged, and also the superficial veins. It is hard, and of a reddish tinge. Should the disease continue to advance, the pain is increased, and ulceration commences at the toes, which are successively destroyed, or large ulcers form on other parts of the foot. Unhealthy granulations occur on the toes, thus reduced to stumps, and show little tendency to cicatrize. In some cases, when the thigh becomes involved, the varicose veins burst, with marked relief for a time to the patient.

When elephantiasis attacks the scrotum, the part becomes hot, swollen, and tender. The pain is not, however, limited to the scrotum, but is felt along the inner side of the thigh and at the groin. The form of the tumour is conical, having its apex above and base below. As the constitutional symptoms which usher in the complaint subside, the swelling decreases to a certain point; and with the recurrence of another attack similar symptoms return, and a corresponding accession is given to the size of the tumour, which may at length reach to the knees. Unless the swelling be great, it usually preserves its form, but the penis is concealed in its large folds. Sometimes the raphé deviates from the middle line, or cracks are seen, from the skin being suddenly and tightly stretched. Abscesses occasionally arise in different parts of the scrotum.

It sometimes happens that during the febrile paroxysm a clear discharge exudes from the skin of the scrotum. This is looked upon as a favourable sign.

Elephantiasis is frequently connected with hydrocele; and in a case that Professor Ballingall[1] operated on, he found, on removing the tumour, that he had inadvertently opened a hernial sac. The swelling in this instance weighed forty pounds, and although the after symptoms were at first severe, the patient perfectly recovered. Sometimes mortification happens, or the skin with the subcutaneous tissue sloughs, exposing the testes. Elephantiasis of the genitals, like the same disease occurring in the lower extremities, is, without doubt, largely influenced by locality.

Treatment.—In an early stage, and when situated in the lower extremities, an attempt should be made to reduce the size of the limb by even pressure. For this purpose cotton or flannel bandages, or, better still, a Martin's elastic bandage, should be applied from the toes and carried beyond the line of the swelling. Ointment containing iodine, or iodine friction, will be also of assistance. The biniodide of mercury, in the proportion of one grain to four drachms of cerate, rubbed into the part, has been productive of benefit, and is recommended by Mr. Day. The first effect of its application, he says, is to occasion some irritative fever, and even an increase in the size of the limb, with more or less pain; but as the latter subsides the swelling diminishes. Combined with this treatment absolute rest is essential. To improve the general health, bark may be given, but no remedy possesses a specific action on the disease. I have known it arrested by the above treatment, and in one case it seemed to lessen from the exhibition of small doses of mercury. How far any

[1] 'On the Operation for Elephantiasis Scroti, with Cases and Remarks,' *Transactions of the Bombay Medical and Physical Society*, vol. viii. p. 232, by Assistant-Surgeon G. Ballingall.

change of climate might prove of service in this country I cannot say, but a removal to a distant station in India, unless the complaint be far advanced, is generally followed by a remission of the local symptoms. The swelling may even disappear, but a relapse is almost sure to arise on the patient's return to his former abode. If this resource prove unavailing, or the complaint occur in a cold climate, the only alternative is amputation at or below the knee. The operation may be safely undertaken in so far as the disease is not likely to recur, and the patient's health warrants such a procedure. In those instances where the thigh is likewise invaded, deligation of the femoral artery has been recommended. It was originally proposed by Dr. Carnochan of New York, and one of the first to adopt it in this country was, I believe, Mr. Butcher, of Dublin. The patient recovered without a single bad symptom, and she was finally enabled to follow her occupation, which was that of a laundress.

The difficulty in tying the artery in such a case is greatly increased by its unusual size, as well as by the risk of wounding, on account of their engorgement, the superficial or the femoral veins. In several cases, the benefit thus gained has been only temporary, and the disease has recurred, with no mitigation of its former symptoms, and after only a few months' interval.

In elephantiasis of the genitals the tumour should be removed. In the native hospitals at Calcutta and Bombay, these growths have been successfully amputated when they have weighed 100 lbs. and upwards.

In one case that came under the care of Professor Ballingall, at the Jamsetjee Jeejeebhoy Hospital, July 20, 1862, he commenced the operation by transfixing the neck of the tumour in the middle line, the knife emerging at the perinæum. A strong double ligature was then passed through the opening, and brought up round each side. After tightening the ligatures by tourniquets, the whole mass beyond the testicles was rapidly removed by a double-flap incision. The tumour weighed, after removal, 106½ lbs. The after shock was very great, in consequence of reaction not being properly established for some days, and in consequence of a heavy loss of blood the following day. The recovery was, however, afterwards uninterrupted, and on September 4 the patient was discharged, cured.[1] G. N.

Frambœsia (yaws).—This is an exanthem rarely, if ever, seen in England; it has, however, been met with in the North of Scotland and in Ireland; it is common in the West Indies and Africa. At the onset there is slight fever, which is soon followed by an eruption of small papules, which increase in size till they attain a diameter of half an inch; the crop of papules is not completed at once; new ones appear whilst the old ones are declining. The eruption is greatest, and the spots are largest, on the face, axillæ, arms, groins, and pudenda. After eight or ten days the eruption becomes pustular, and a crust is formed, beneath which a foul sloughy ulcer is found. On the surface of this ulcer red fungous granulations spring up. These ulcers exist in all stages on the body at the same time, and are often accompanied with ulceration of the throat. The eruption may continue from a few weeks to seven or eight months; after a time the sores contract and cicatrise, leaving no mark unless the inflammation has run high. The disease is followed by much emaciation and debility, and frequently by dropsy. Frambœsia is transmitted by contagion; it has been communicated by inoculation. It is rare amongst the white races of mankind.

Treatment.—Locally, mild stimulating ointments; internally, tonics, nutritious food, and occasional alteratives; aperients appear to be indicated. Mercurials have been used in former times, but are now generally believed to be worse than useless.

T. H.

Keloid tumours.—The first to recognise keloid growths as a separate class of tumours was Alibert, who describes them as of a reddish colour, sometimes streaked with white lines, not pedunculated, but rather embedded in the substance of the skin. To the touch they are elastic, like fibro-cartilage, and moreover they are not malignant.

Their origin, I believe, is derived from the cutis itself, and not from the subcutaneous tissue, which is seldom implicated. In structure they partake, and that

[1] 'On the Operation for Elephantiasis Scroti, with Cases and Remarks,' *Transactions of the Bombay Medical and Physical Society*, vol. viii. p. 233, by Assistant-Surgeon G. Ballingall.

largely, of the fibrous element, and are highly vascular; this is shown by the number of capillaries ramifying on their surface. The cuticle is sometimes wrinkled, but more generally remarkable for being soft and smooth. There is, in the College of Surgeons, a beautifully injected preparation, which was presented by the late Mr. Edward Stanley.[1] It is an ordinary keloid growth of the leg, resulting from a scald, and extending several inches in the form of a tumour, narrow and not much raised. Its uniformly red surface contrasts with that of the surrounding skin; and, except where it has been removed by ulceration, the epidermis is intact.

Keloid tumours present great variety of appearance. The growth may be confined to a single tumour, smooth, ovoid, and hemispherical; or several of these may be seen at short distances from one another, and in various stages of development. Again, the part affected may be distinguished by irregular but not prominent projections, traversed by numerous bands, or sending out processes or claws in the direction of its growth. As the consequence of a cicatrix, the form of the tumour will correspond to the extent of the primary lesion.

In its early stage the growth is not usually painful, but its character in this respect is often much modified by the health or temperament of the patient. Thus, should there be a tendency to hysteria in the female, or over-sensitiveness of irritability in the male, more annoyance will be experienced from the presence of the tumour than where no such disposition prevails. In many instances no inconvenience is felt, unless the part has been much manipulated, when it itches, or is said to 'burn'; or unless it be constantly pressed upon, as for example when occurring on the scapula in a line with the border of the dress. Sometimes the patient complains of pain, which the least handling increases. At a later period, should ulceration take place, pain is always more or less felt, but it is not determined by the size or growth of the swelling.

Keloid tumours are not limited to any locality. Perhaps they may be said to be most common over the scapula, and next to this over the sternum. Sometimes they show themselves on other parts of the trunk, or upper extremity, or face, but seldom on the lower limbs.

However obscure the real origin of these tumours, a singular predisposition to their production is declared in certain constitutions, whether in the development of new growths or the recurrence of a similar swelling from the cicatrix of one that has been removed. Velpeau relates the case of a lady, from whose breast he excised a tumour of this kind, and who had undergone the operation on two occasions before she applied to him, and again it appeared for the fourth time.[2] It would be easy to multiply such instances as these. The same liability to return is often observed when, instead of being excised, the mass has been destroyed by caustics, or removed by ligature; and so great is it in some cases that the apertures caused by the needles in closing the wound have shortly become each the seat of keloid tubercles. In one example, which Mr. Longmore lately brought before the notice of the Medico-Chirurgical Society,[3] the whole of the back, the greater part of the chest and the face, were studded with keloid excrescences; the only evidence of an exciting cause was afforded by a 'prickly heat,' to which the patient, a soldier, had been exposed while serving in India. The disease was aggravated by the use of the cross-belt, and scarcely, if at all, increased in cold weather. This man never suffered from small-pox or secondary syphilis, and I may add that he was doing duty in the Deccan, where prickly heat is far less severe than in the plains of Hindostan. The effect of some injury to the skin is in most cases the immediate cause of a keloid tumour. Among soldiers it not unfrequently follows flogging; in other cases it succeeds gunshot wounds, and particularly burns. The scars of small-pox or rupia, and even leech-bites, have been known to become the seat of keloid tumours.

There is a species of keloid to which Addison has drawn attention, and which he describes as true keloid. How far it merits this distinctive title I am not about to

[1] Preparation 2283 B.

[2] Velpeau, *On Diseases of the Female Breast*, translated by W. Marsden, M.D., 1856, p. 57.

[3] *Remarks on two Cases of Kelis*, by T. Longmore, vol. xlvi. p. 105.

discuss; but that the term keloid tumours cannot appropriately apply is, I think, sufficiently evident to any one who examines the models from the originals of which the observations of Addison were derived. Commencing as a white spot, it sometimes spreads in a circular, but more commonly in a linear direction, and in many cases is attended by no elevation of the surface. The skin appears infiltrated, or, to use his own words, 'hide-bound,' and this so far affects the subjacent fascia and muscles as to interfere greatly with their free motion. Generally the skin is of a yellowish colour, and the patch is more or less covered with scales.

Treatment.—In the treatment of keloid tumours we should remember that they are sometimes much affected in their growth by the state of the general health, and that they occasionally disappear. The influence of these conditions should not be overlooked or undervalued, as although the removal of the mass may be readily performed, the risk of its return is always considerable. We may endeavour to promote absorption by painting the part with tincture of iodine, diluted at first, and gradually used pure; or collodion may be employed with a similar object. In one instance related to me by Dr. Broadbent of extensive keloid growths, the latter disappeared or became much reduced from the internal use of iodide of potassium; and in a case of doubtful origin it may be worth while to try the effect of this remedy. The contra-indications to an operation are these:—1st, when the disease shows an inclination to become developed in other parts—in such a case, if excised, it is almost sure to recur; and 2nd, when it has already been so extensive as to preclude any resort to the knife. In these no treatment that I am aware of is of any avail. Rayer, indeed, recommends pressure, but this is more likely to increase than mitigate the evil that already exists. G. N.

Xanthoma, Xanthelasma, or Vitiligoidea.—This peculiar affection was first described by Drs. Addison and Gull under the name of Vitiligoidea. It appears to consist essentially in an overgrowth of fibrous tissue in the true skin and subjacent parts, associated with much fatty degeneration in patches or the deposition of oil in aggregations of minute globules, and with the precipitation of yellow pigment. It has a good deal of resemblance to the atheroma of arteries.

It occurs in two forms, x. planum and x. tuberosum. The former, which is the more common, affects mainly the eyelids, but also attacks the ears, various other parts of the face, and the mucous membranes. The tuberous form, though occasionally observed in the same parts, implicates especially the flexor aspects of the joints, with the sheaths of tendons, the palms and soles, and other regions of the limbs. The two forms may exist in combination, and may affect between them any part of the surface.

In the plane form of the disease the affected portions of skin present an opaque buff colour, are abruptly marginated, and though perhaps looking at first sight thickened, are really not raised above the level of the surrounding skin. Moreover, in softness and pliability there is little or no difference between them and the healthy parts. The affection commences symmetrically in the upper lids near the internal canthus, and thence slowly spreads until in some cases both lids becomes involved in their whole extent.

In the tubercular form, the affection is also for the most part symmetrical. In it papules and tubera arise, varying from the size of a pin's-head to that of a hazel-nut, and sometimes by their aggregation form nodulated masses of considerable extent and thickness. These are generally yielding, elastic, and but little indurated, are of the normal colour of the skin, reddish or buff-coloured, and often studded, especially in their more prominent parts, with opaque yellow spots. When occurring in the palms and soles, the papules are generally small, close-set, and give a peculiar mottled aspect to the affected surface. On the wrists and ankles the disease sometimes has a close resemblance to keloid.

Xanthoma is for the part unattended with pain or uneasiness; when implicating the hands and soles, however, it often causes a good deal of tingling or itching. It is usually progressive in its course, but occasionally becomes arrested, and now and then disappears spontaneously. It never undergoes suppuration or ulceration.

It is a disease of adult life, and much more common in women than in men. A large proportion of cases (from one-third to one-half) are met with in association with jaundice, due to organic disease of the liver. Mr. Hutchinson points out that many who suffer from it are liable to megrim. Diabetes has been associated with it in a few cases.

All medical treatment appears to be useless. J. S. B.

Order 9.—Maculæ, or Pigmentary Changes.

These changes are seated in the deeper layers of the epidermis, the so-called rete mucosum. They may be classed under two heads—1, those in which there is excess of pigment; 2, those in which there is a deficiency of pigment.

(1) *Excess of pigment.*—Different races of man exhibit very different amounts of pigment in their skin; the natives of hot climates have much, and those of cold climates little pigment. Developmental changes in the organs of reproduction are often attended with an increased production of pigment; and at the age of puberty there is commonly a darkening of the skin of the sexual apparatus. During pregnancy the areola around the nipple becomes of a darker colour; rare cases have been described in which this discoloration has extended at this period much further, even over the whole front of the body. During menstruation the lower eyelids are often discoloured, sometimes from a sort of venous lividity, in others from real pigmentary deposit. Heat and light have the effect of increasing cutaneous pigment, either uniformly or in spots called freckles (*ephelis*). Yellowish-brown, round or irregular, spots or patches are thus produced on exposed parts, especially in persons of fair complexion. When spots of this kind are more permanent than usual, they are called *lentigo* or *ephelis lentigo*. The skin on the front of the legs of old people often becomes of a brown or liver colour; this change is said to depend on exposure to artificial heat. Many skin diseases leave the skin with an excess of pigment, especially psoriasis, eczema, and prurigo.

Cases are on record in which mental emotions have suddenly induced an excessive formation of pigment; it is more common, however, to see from this cause, in the hair, which is homologous with the epidermis, a loss of pigment. The whole hairy scalp has been said to have become grey in a few hours from intense anxiety or grief.

Dr. Addison first called attention to a peculiar discoloration of the skin (a bronzing), which he connected with disease of the supra-renal capsules; it is accompanied by progressive debility, anæmia, occasional giddiness, and gastric disturbance, and terminates fatally at the end of a few years. The colour of these patients is brownish with sometimes an olive-green tint, and it very closely resembles that seen in the darker races of man. The depth of tint varies in different cases, being most marked in the parts most exposed, and also those in which there is normally an excess of pigment; as, for instance, around the axillæ and near the umbilicus. The pathological connection between the cutaneous change and the supra-renal disease is not very obvious; it has been supposed by some that they are both dependent on irritation of the solar plexus of nerves. It appears, at any rate, to be satisfactorily proved that a bronzing of the skin, accompanied by certain constitutional symptoms, not traceable to any other cause, may be safely assumed as pathognomonic of a peculiar morbid change in the supra-renal capsules. The capsule is first changed into a translucent softish homogeneous substance, which after a time is converted into an opaque yellowish material, and at a later period into a putty-like matter, or a dry chalky mass.[1] Other changes occur in the supra-renal capsules, without pigmentary change of the skin, and on the other hand the skin may undergo discolorations very similar to, if not identical with, those accompanying Addison's disease, without the peculiar constitutional symptoms or disease of the capsules. A case of this kind is described by Dr. Parkes, in which the skin of a man aged 59 years, five months after an attack of jaundice, became gradually dark on the body, arms, and thighs, until the hue was that of the skin of a mulatto; over the abdomen, thighs, and scrotum there were white

[1] Dr. Wilks, in *Guy's Hospital Reports*, vol. viii.

patches interspersed; below the knees the skin was of its natural colour. In this case the supra-renal capsules were found quite healthy; the liver was contracted, and had given rise to ascites. Similar cases are also on record in the Pathological Society's 'Transactions' (as *e.g.* vol. xii. p. 262); other instances have been met with, in which the skin was mottled with dark and white patches; two such cases are mentioned by Dr. Addison, and considered by him to belong to the same category of supra-renal disease. In one of Dr. Addison's cases, the capsules were diseased; in the other no post-mortem examination was made. Dr. Wilks doubts whether this peculiar mottling, a combination of bronzing with pallor, or *leucopathia*, is in any way connected with supra-renal disease.

Moles (nævi lenticulares, or liver stains) are congenital spots or patches in which there is an excess of pigment.

They are sometimes round, sometimes of irregular shape; and they have either a brown, yellowish-brown, grey, or blackish colour; occasionally they are covered with hairs, which are thicker, stiffer, and darker than the hair of the adjoining skin.

In size they vary from a pin's head to a diameter of several inches. They are either quite flat, or raised above the level of the surrounding skin. There may be one or many of them on one person.

They are formed by an excess of pigment in the deeper layers of the cuticle, which is often thicker than it is on other parts of the surface; and in those moles which project above the level of the skin there is a thickening also of the derma.

They are occasionally the seat of troublesome ulceration, from friction or other cause. In such cases it may become advisable to excise them; and this is the more desirable since they are believed to be often the seat of epithelial cancer in after life.

(2) *Want of pigment.*—This may be congenital and universal, involving not only the skin, but the hair, the iris, and the choroid, constituting *albinism*. Several albinoes have been met with in the same family, or one member only of a family is affected. Albinism has been observed to be transmitted by inheritance to one sex more than to the other; in one family preferring males, and in another females. This affection occurs occasionally in all races of mankind, but it is more common in hot than in cold climates. There is intolerance of light, and usually a want of power both in body and in mind.

Partial loss of pigment is also more common amongst the darker races, at any rate it has been more noticed amongst them. Negroes congenitally 'piebald' are by no means very uncommon.[1]

Vitiligo is a term differently used by different writers. It is now commonly employed to designate patches characterised by loss of pigment. In some cases there is a slight depression of surface in these white patches, with branny desquamation.

Silver stain.—The internal use of the salts of silver for a long time produces a peculiar livid or slate-coloured tint of skin. No remedy is known for this condition.

Besides the changes of colour above described, there are some rare cases on record in which a free excretion of pigment has taken place on the eyelids; in some cases black, in some yellow, and in others blue. The fluid in which the pigment appears is somewhat unctuous, and the affection has hence been called stearrhœa nigricans, flavescens, and cærulea.[2] The secretion may be wiped off; but appears again at the end of a few hours. The subjects of these cases have generally been women who have suffered from uterine derangement; some of these changes have no doubt been simulated by hysterical patients. Whether the secretion has come from the sebaceous glands or sweat-glands has not been clearly demonstrated—probably from the former. T. H.

[1] The pigment is sometimes unevenly distributed, so that there is an excess of it in some parts and a complete loss of it in others.

[2] Dr. Laycock, *British and Foreign Med.-Chir. Review*, vol. xviii.

Order 10.—Parasitæ.

Tinea is the generic name of all the diseases of the skin characterised by the presence of vegetable growths in the substance of the hair.

Tinea tonsurans is a very common disease of the hairy scalp, seen almost exclusively in children, and by far the most frequently between the ages of two and twelve years. It is called *Porrigo scutulata* by Willan, *Herpes tondens* by Cazenave and G. Simon, and *Trichosis furfuracea* by E. Wilson.

Tinea tonsurans occurs in more or less circular patches varying in size from a sixpence to a crown-piece. All the hairs on the patches appear to have been evenly cut off at about an eighth of an inch from the surface of the scalp. These short hairs are much thicker and more opaque than are the hairs on the other parts of the head, and as the diseased hairs have lost their elasticity they are here and there twisted or bent at an angle on themselves. The surface of this patch is generally covered with numerous loosely attached opaque white scales, and imbedded in these are many opaque, thick, twisted short hairs. When the scaliness of the patch is trifling, the orifice of each hair-follicle may be observed to be surrounded by an opaque white fringe, formed of accumulated epithelium, and the hair-follicles themselves are too prominent.

The patches on which the hairs, &c., are thus diseased are very slightly raised, and are a little redder and hotter than the other parts of the scalp.

Microscopic examination.—The thickness, opacity, brittleness, and loss of elasticity of the hairs are seen by the aid of a magnifying power of two hundred diameters to be due to the presence in the substance of the hair of a vegetable parasite. The scales are formed of epithelium, studded with the sporules and mycelium of the same parasite. The plant is the trichophyton tonsurans; the sporules of the plant are found between the inner root-sheath of the hair-follicle and the hair; from this spot the parasite enters the hair; and the mycelium, bearing innumerable sporules, passes between the anatomical elements of the hair, separating them from each other in the most remarkable manner. Passing up from the interior of the hair-follicle to its orifice, the mycelium and sporules spread in all directions among the epithelial scales.

Pathology.—Some writers maintain that tinea tonsurans and herpes circinatus are the same disease. The closeness of the relation between the two is shown by the fact that a patch of herpes circinatus seated on the forehead or back of the neck, as not infrequently happens, and extending in size till the upper part of the ring involves the hairy scalp, may retain on the hairless part the characters of herpes circinatus, while that portion of the ring which occupies the hairy scalp has all the characters of tinea tonsurans; and also by the fact, that in the scales which can be scraped from the surface of the red ring of herpes circinatus of the trunk are occasionally to be found some of the mycelium and sporules of the little fungus.

But, on the one hand, a patch of herpes circinatus is often seen on the trunk, and occasionally on the scalp, without a trace of the trichophyton to be detected among the débris of its vesicles; and, on the other hand, a patch of tinea tonsurans is occasionally seen on the scalp, on and around which no trace of herpes circinatus can be found.

From these facts it follows—

1st. That herpes circinatus and tinea tonsurans are distinct diseases.

2nd. That tinea tonsurans owes its peculiar characters to the presence of a parasitic vegetable growth.

3rd. That the secretions of the part of the skin affected with herpes circinatus form a favourable nidus for the growth of the parasite.

In tinea tonsurans there is first some disorder in the secretions of the hair follicles—a disorder, it may be, attended with no changes perceptible to the eye. If sporules of the trichophyton tonsurans fall on the soil so prepared they take root; the plant grows downwards between the hair and its root-sheath—outwards, upon and among the epithelium of the scalp upwards into the hair, penetrating it, and passing into its shaft. To the existence of the parasite all the visible phenomena are due. Its presence in the substance of the hair causes its increased thickness, opacity, loss of

elasticity, and brittleness. Its presence in and among the epithelium leads to the desquamation of the latter, and, as a consequence, to the abundance of the scales; its presence in the hair-follicles to the swelling of the follicles and to the little fringe around their orifice, and also to the determination of blood to the part. The elevation of the part and its increased temperature are consequent on the flow of blood to it. Tinea tonsurans is undoubtedly contagious.

Treatment.—The great object to be attained in the treatment of tinea tonsurans, whether the disease be primary or engrafted on herpes circinatus, is the destruction of the plant; for so long as the fungus is present, so long will there be increased flow of blood to the part, secretion of a substance favourable to the growth of the plant, and, as a necessary consequence, persistence of the conditions of hair and scalp resulting from the presence of the plant.

How can we destroy or remove the plant? We are acquainted with various agents destructive to vegetable life. The application of any one of these to the diseased patch would no doubt quickly effect our object, were it not for the difficulty of making the parasiticide penetrate into the substance of the hair as low as its root, and pass down to the base of the hair-follicle.

Such preparations are the following—bichloride of mercury four grains, lard two drachms; acetate of copper half a drachm, lard four drachms; ammonio-chloride of mercury twenty grains, sulphur ointment four drachms; strong blistering fluid; creosote twenty drops, lard two drachms; carbolic acid 1 part to 300; strong sulphuric acid, washing the part directly after with cold water; and a saturated solution of sulphurous acid. Although any and all of these means will sometimes effect a cure, I am disposed to prefer as most uniformly successful the sulphur and white precipitate ointment. Dr. Gull, I am told, has found the strong sulphuric acid rapidly cure the disease. Dr. Coster of Hanwell Schools employs a solution of two drachms of iodine in one ounce of oil of tar; this solution is to be painted on the part with a firm brush.

Whatever treatment may be adopted, cleanliness is essential. The patches should be well washed from time to time, so as to remove the scales, and with them innumerable sporules and much mycelium. As a detergent a solution of borax will be found useful. The parasiticide ointment should be well rubbed into the part at least twice a day.

It has been proposed to pull out the hairs from the patch; and no doubt the success of the epilation would be marked, if it were possible to perform it. But epilation is impracticable; the hair breaks off just above the point where it emerges from its follicle. In rare instances only can the root of the hair be extracted, and in rarer instances still can the root-sheath be got out with the hair. Blistering the part assists in the removal of the hairs. As the secretion of the hair follicles in strumous children seems particularly favourable to the growth of the trichophyton tonsurans, cod-liver oil is useful.

It is satisfactory to know that although tinea tonsurans may be very obstinate, it always disappears after a time, and, further, that it never causes even partial baldness.

Tinea favosa or favus, though common in Holland and some other parts of the Continent, is a rather rare disease in England. Its ordinary seat is the hairy scalp. Now and then, however, it occupies other parts.

Be it situated on scalp, trunk, or extremities, the disease is primarily seated in the hair follicles, and is characterised by dry brimstone-yellow crusts, each crust being cup-shaped, and having a hair running through its centre. The size of the crust varies from a mere point to half an inch in diameter. The separate crusts coalesce as they increase in size and number, and thus a large, dry, irregularly-pitted crust is formed. The crusts are buried to some depth in the cutis, so that if one be raised from its place, a depression of the cutis is exposed in which it was imbedded. The depressed surface is always redder than healthy skin; but only here and there is the cutis denuded of its epithelial covering. Among the dry crusts are usually a few pustules. These pustules are an accidental complication indicating the coexistence of impetigo.

The crusts of tinea favosa have a peculiar fœtid odour, and from the impediment

they offer to cleansing the head favour the occurrence of vermin. The pediculi are found chiefly in the fissures of the large crusts. Intolerable itching is often experienced. There is a variety of tinea favosa in which the crusts are from the first amorphous, wanting in the cup-shaped character, and less bright in colour.

Microscopic examination.—The pus from the pustules contains the corpuscles characteristic of that fluid. The dry yellow crusts are composed of the mycelium and sporules of the achorion Schönleinii. The sporules of the achorion Schönleinii are oval, and much larger than those of the trichophyton. The mycelium and the sporules can both be seen readily in the hair which runs through the centre of each dry sulphur-coloured crust.

The steps of the disease are these:—First, there is thickening of the root-sheath of the hair follicle, and accumulation of its secretion about its orifice. So long as there is nothing more than this, we are not able to say that any disease exists; but let the sporules of the achorion fall on the prepared soil, and the sulphur-coloured crusts of tinea favosa are rapidly formed. The plant grows outwards between the layers of epithelium, downwards into the follicle, and, entering the hair near to its root, shoots upwards into its substance.

The trichophyton tonsurans, the plant proper to tinea tonsurans, grows into the hair-follicle; but its presence inflicts no permanent injury on the structures of the follicle. The achorion Schönleinii, unless it be soon eradicated, destroys the follicle, and permanent baldness is the consequence.

Herpes circinatus bears the same relation to tinea favosa that it does to tinea tonsurans. The secretion of herpes circinatus is as favourable to the growth of the achorion as it is to the growth of the trichophyton. Tinea favosa is, like all the diseases of its class, contagious; but the achorion requires a favourable soil for its growth. The disease rarely spreads in the hospital.

The writer had a case of tinea favosa for some time under his care in the Hospital for Sick Children: not a child caught it till a case of herpes circinatus was admitted into the same ward. On several children rings of herpes circinatus soon after appeared; and two of the children thus affected now caught tinea favosa, and the crusts of the tinea favosa occupied the centre of the patches of herpes circinatus.

As these cases are of interest from their bearing on the pathology of the affection, one may be quoted at length.

On the outer aspect of the right arm, just below the elbow, is a pinkish-red patch, slightly elevated, nearly circular, and five-eighths of an inch in diameter. The centre of this patch is occupied by ten or twelve crusts of tinea favosa, the largest not more than a line in diameter, the smallest requiring a lens for its detection. The largest are distinctly depressed in the centre, the smallest are merely yellow spots. Through the centre of each crust runs a little hair. A few white scaly-looking points are scattered around the part occupied by the crusts. The circumference of the patch is covered by pretty closely set, flattened vesicles; the majority so small that they might escape observation, unless the part were examined with a lens.

On the right shoulder, the left upper arm, and the left leg, are patches of similar character.

Passing from the circumference to the centre of the patch are—

1st. A ring of the vesicle of herpes circinatus.

2nd. Scales formed by the drying of the vesicles.

3rd. Crusts of tinea favosa.

Some of the crusts are mere points, the disease being limited to the very orifice of the hair-follicles. There are no pustules; not a trace of suppuration; a sufficient proof that the disease is not pustular at its commencement.

As without the existence of the plant trichophyton there could be no such disease as tinea tonsurans, so in regard to tinea favosa, were there no such plant as the achorion Schönleinii, there could be no such disease as tinea favosa. The soil requires preparation; but all the visible phenomena of the disease—those appearances which we call tinea favosa—are the direct consequences of the presence of the plant.

Treatment.—The objects to be kept in view in the treatment are to remove or destroy the plant, and to improve the state of the secretions of the part which is its seat. As the subjects of tinea favosa are often strumous, benefit is obtained under such circumstances from the administration of cod-liver oil, syrup of iodide of iron,

calumba, rhubarb, and soda, and other remedies of the same class. But all other means will fail unless the plant be destroyed and removed. For this purpose, parasiticide substances—that is to say, substances destructive of vegetable life—are to be applied, and at the same time so much of the plant as possible removed by mechanical means.

The crusts are to be removed by a bread-and-water poultice, or, better still, by the continuous application of lint dipped in a solution of sulphurous acid. Bichloride of mercury dissolved in water or mixed with lard in the proportion of eight grains to the ounce, and acetate of copper mixed with lard, half a drachm to the ounce, are two of the most powerful parasiticides. A saturated solution of sulphurous acid properly applied is an excellent remedy; a piece of lint dipped in the solution is to be closely and constantly applied to the affected part, and this covered to prevent evaporation by oil-silk, or by a second piece of lint spread pretty thickly with lard. If the disease be on the trunk or extremities, and the general health good, it may be rapidly cured in this manner. The girl whose case is above described was permanently cured in a few days. But if the disease be seated on the hairy scalp, and the plant has entered the hair-follicles, and shot up into the hairs themselves, considerable difficulty is experienced in bringing the parasiticides in contact with the plant, and, as a consequence, epilation is almost essential for permanent cure. If the hairs be pulled out before the hair-follicle is destroyed, no baldness follows. Epilation may appear to be a very painful operation, but if well performed it is not so. Each hair should be grasped with a pair of forceps adapted to the purpose just where it escapes from its follicle, and pulled sharply in the line of the direction of its insertion into the follicle. As the hairs are much less firmly fixed in their follicles than in health, epilation is so much the more easily effected. If the disease be limited in extent, no practical difficulty exists to its cure by epilation; if it occupies the whole or a great part of the scalp, the cure requires much time and great patience. So long as a sporule or a branch of mycelium remains in a hair undestroyed, so long is it certain that the disease will return.

Before epilation, l'huile de cade is by many applied to the part from which the hairs are to be removed. It is said to diminish the sensibility, and loosen the attachment of the hair to its follicle. The old pitch-cap was merely a quick mode of epilation, and not so painful as might be supposed. If herpes circinatus be present, the extension of the ring of vesicles should be prevented, and on their first appearance the small patches of herpes should be destroyed with nitrate of silver.

Tinea favosa is the disease described by Bateman under the name of porrigo lupinosa. The porrigo favosa of Willan, Bateman, and Thompson is a species of impetigo. These excellent observers mistook the yellow crusts of tinea favosa for dried pustules.

Tinea sycosis, or *mentagra*, as it is often called, is a disease of the beard, moustache, whiskers, and inner surface of the nares, in which a little fungus finds a nidus between the root of the hair and the wall of its follicle. The plant is the microsporon mentagrophytes, and it makes its presence known by the inflammation it excites. The inflammation causes thickening and induration of the tissues around the follicle, and suppuration of the follicle itself. As the disease originates in the follicle, a hair may be seen to traverse the centre of each pustule. The pus and epithelium about the orifice of the follicle dry into a thick brownish scab. When the scabs are numerous, and the parts about tuberculated from the swollen and irregular induration around the follicles, the part affected with pus being supposed to have some resemblance to the pulp of the fig, the name sycosis has been given to it. Between the scabs are often seen little scaly particles, formed of epithelium. Sycosis may be confounded with impetigo; but the induration and swelling of the tissues is trifling in impetigo. Acne of these parts also may be taken for sycosis; but in acne the induration is greater than in sycosis, and the suppuration less rapid. There is no vegetable parasite in the hair-follicles in impetigo, nor in the sebaceous follicles in acne.

Tinea sycosis is often a very obstinate affection.

The *treatment* of this disease is to be conducted on the same principles as those of the other affections of its class. Substances destructive to vegetable life are to be applied to the diseased skin; and as the plant is *in* the hair-follicles, they must be applied in a form fitted to enter the follicles. An ointment of lard and corrosive sublimate, in the proportion of a grain to the drachm, is sometimes very useful. The white precipitate ointment of the London Pharmacopœia may effect a cure. Dr. Thompson recommends strongly an ointment composed of a scruple of iodide of sulphur and an ounce of lard. Warm fomentations and poultices, by removing the scabs and allaying the inflammation, afford much relief to the patient. The condition of the digestive organs must be attended to, and purgatives, tonics, and antacids exhibited as required. A good and generous diet is usually necessary. Epilation is sometimes essential for effecting a cure.

Tinea or *pityriasis versicolor*, or chloasma, is a very common disease. Its most frequent seat is those parts of the neck, upper arms, chest, and abdomen, which are covered by the flannel jacket. The axillæ, however, usually escape. It is curious to note how often the disease is limited exactly to the parts in contact with the flannel. In such cases its occurrence is favoured by want of cleanliness.

Many people are so dirty in habit as to wear the same flannel next their skin for a week, a fortnight, three weeks, and, among the poor, even a month. And it is by no means an uncommon thing for them to wear the same flannel night and day, not once removing it from the moment it is put on till the time it is considered to be desirable to have it washed. The consequence of such habit is an accumulation on the surface of the skin of its secretion and of undetached epithelium, and the consequent formation of a nidus favourable to the growth of the microsporon furfurans. This plant finding, then, in the epithelial accumulation saturated with the secretions a fitting soil, spreads under its outer layer in all directions, and by its presence produces the pale yellowish-brown patches characteristic of chloasma. At the margin of the larger patches are numerous detached brownish-coloured circular spots. The spots are scarcely raised above the surface of the skin. Like all the other vegetable parasites, the microsporon furfurans exhibits a disposition to spread from the point on which it alights uniformly in all directions. Hence the circular form of the patches. The large irregularly-shaped patches are formed primarily by the coalescence of the smaller. If one of the brownish patches be rubbed, a number of minute scales will be detached, and the cutis underneath will be seen to be somewhat redder than the adjacent skin. The only annoyance the patient experiences is itching of the part on exercise or when heated, and the consciousness of having very unpleasant-looking skin beneath his jacket.

No doubt some persons who are very cleanly in their habits, and some who are as cleanly as their clear-skinned neighbours, suffer from chloasma. One concludes, therefore, that in some instances the secretions of the skin are abnormally favourable to the growth of the fungus.

Phthisical people often have patches of chloasma on their chest or elsewhere. This is the result, partly at least, of want of cleanliness. Persons delicate in the chest, as they call it, are frequently afraid of washing more than face and hands. Again, they usually keep themselves closely wrapped in flannel, and are somewhat too fearful of changing it; and, yet further, sweating, alternating with heat of skin, is common in such cases—conditions favourable to the formation of a good nidus for the microsporon furfurans.

Like all the parasitic diseases, chloasma is contagious.

Microscopic examination.—If one of the delicate scales from a patch of chloasma be placed in a little alkaline fluid, and examined with a magnifying power of 250 diameters, it is seen to be formed of epithelial scales studded with the mycelium and sporules of the microsporon furfurans. If to the scale water only be added, the plant will not be visible. The alkali renders the animal matters transparent, and leaves the plant unchanged. The microsporon is seated on the under-surface of the

epithelial scales, no part of the plant projecting beyond the margin of the scale on which it grows.

Treatment.—To cure the patient, his dirty habits must be reformed, supposing him to be of such. He must change his flannel frequently, and never sleep in that which he wears during the day. He must wash daily, not merely his hands, but his whole trunk and extremities, using hot water and strong soap. After washing he must rub the surface well with a flesh-brush, taking care that the latter is itself often cleansed. In addition to these frequent and careful ablutions and frictions, by which a large quantity of the fungus is removed, the patient should bathe the part affected with a parasiticide lotion, composed of twelve grains of bichloride of mercury to four ounces of water. The lotion should be allowed to dry on the part. A saturated solution of sulphurous acid may be applied freely with the same object, viz. to kill the fungus. A lotion of sulphuret of potassium, one drachm to the pint of water, will cure; but then it is offensive. Some consider a course of arsenic essential to the permanent cure; but it is not so. Cod-liver oil may be of service in some cases.

The following appears to me to be the present state of knowledge on the subject, and on the relation between the parasites of the parasitic skin diseases and between herpes circinatus and parasitic diseases.

1. That herpes circinatus may occur without any vegetable parasite being able to be detected on the part.

2. That trichophyton tonsurans is frequently present in the scales of h. circinatus and in the hairs of the part.

3. That if a wet bandage be applied over the skin of a part on which trichophyton tonsurans has been scattered, patches identical with those of herpes circinatus containing the parasite are produced.

4. That microsporon furfurans can be inoculated in the same manner, but then no other disease than chloasma follows.

5. That if achorion Schönleinii be inoculated, tinea favosa is produced, but that an herpetic stage resembling h. circinatus precedes the favus stage, and that in some cases the disease aborts at the herpetic stage, no favus crusts being formed.

6. That patches of true herpes circinatus are more liable than other parts of the same person to be inoculated with achorion Schönleinii and so to have favus crusts form in their centre.

7. That the lower animals, the cat especially, suffer from tinea tonsurans and tinea favosa, and that man may be inoculated from the lower animals.

8. That the microscopic characters hitherto noted of the various parasitic fungi, while amply sufficient to enable the one plant to be distinguished from the other, are not sufficient to prove their essential non-identity—*i.e.* to prove that they are not different stages of development of the same fungus.[1]

With reference to the nomenclature of these diseases, characterised by the presence of vegetable parasites, it should be remembered that—

Tinea tonsurans was called by Willan and Bateman porrigo scutulata;

Tinea favosa was called porrigo lupinosa;

Chloasma was called pityriasis versicolor; while the

Porrigo favosa of the same authors was a variety of impetigo.

[1] Höbner u. Strabe, *Klin. u. exp. Mittheilung*, Canstatt, J. B., 1864. Starck u. Hallin, *Jena Zeitschrift*, Canstatt, J. B., 1865. Pick, *Untersuchung in der Pfl. Hautkrankheiten.* McCall Anderson, 'On the Identity of the Parasites met with in Favus, Tinea Tonsurans, and Pityriasis Versicolor.' [I should like to express my own opinion that the parasites of the three parasitic diseases, ringworm, favus, and chloasma, are absolutely distinct from one another, and that, allowing the existence of circinate forms of erythema, lichen, and herpes independent of parasitic influence, still in the great majority of these affections a parasite will be found, and that in the great majority of cases therefore they are simply varieties or stages of ringworm or favus.—J. S. B.]

Scabies.—The eruption of scabies is caused by the presence of a minute animal parasite, the *sarcoptes hominis*, in the under layer of the epithelium. The sarcoptes hominis has been taken from its burrow, placed on a healthy person, and the disease in that way communicated. It is by the passage of the parasite from one person to another that the disease spreads; hence the hands in the adult, and the buttocks and loins in children too young to walk, are the especial seats of the disease. In children the hands often escape; in adults the parts of the hands where the skin is most delicate are the parts first to suffer, *i.e.* between the fingers, the bend of the wrist, the root of the thumb, and the inner margin of the hand. Scabies never affects the hairy scalp or the face of the adult, and only rarely the face of the child.

The eruption appears to be produced thus: The animal bores a way through the outer layer of the epidermis, and then for some distance onward, in the softer layer of the epidermis. Immediately adjacent to the point at which the animal passes into the epidermis, a vesicle, papule, or pustule is formed. The sarcoptes itself is found at the end of the faint whitish line or burrow leading from the vesicle or papule. The burrow varies from a line to an inch in length. When the disease affects the delicate skin between the fingers or toes, and continues for some time, the cuticle thickens and cracks. These cracks are very characteristic of the disease; the vesicles, papules, and pustules, and the delicate line leading from a few of these, are the only disease of the skin directly resulting from the animal's presence. The blackish points, the linear abrasions, the broader inflamed patches, and the ulcers so common in the young child, are the consequences of injury inflicted on themselves by the patients, in their endeavour to allay the intolerable itching. Hebra has pointed out that when the paralytic are the subjects of itch, none of these severer effects of scabies are observed. The vesicles of scabies are scattered irregularly over the part affected; many of them seem buried somewhat in the skin, so that they may be mistaken for papules. These deep-seated vesicles are never acuminated, and there is little or no redness around them; on the apices of some of the papules a minute vesicle may be detected by the lens; those vesicles, the vascular character of which is more evident, are acuminated, and may or may not have some redness around. The phlyzacious pustules often attain a considerable size.

The superficial acuminated vesicles are best seen between the fingers and toes and at the bend of the wrist, the disease being recent; the cracks in the same situations when the disease has lasted some time; the buried vesicles on the upper extremities, and where the epidermis is naturally rather thick; the burrows of the sarcoptes on the sides and anterior aspect of the fingers. It is a matter of some interest, as showing the accidental nature, so to say, of the eruption, to know that some good observers have recorded cases in which there were no vesicles, pustules, or papules, only the burrows, at the extremities of which were found the sarcoptes; the itching in these cases was as severe as in those attended with an eruption. In old persons, whose skins are thick and not very sensitive to irritants, the eruption is often trivial and papular in character. The disease is then not infrequently confounded with prurigo. The itching in scabies is very decided and severe, and greatly increased by warmth. The amount of inflammation and ulceration that may accompany the disease when it affects the delicate skin of young infants is likely to lead to a mistake as to its nature. Vesicles and pustules sometimes form under the thick cuticle of the sole of the feet, and are very characteristic of the disease.

Scabies never disappears spontaneously. I have seen cases where the disease has lasted for years, its nature having been misunderstood.

Prurigo and eczema often complicate scabies; urticaria less commonly; and in rare cases blebs form on the irritated parts.

Treatment.—Sulphur is the best remedy for scabies. It cures the disease by killing the sarcoptes. In the St. Louis Hospital at Paris, two hours' treatment is considered sufficient for the cure of the disease. The patient, after being well washed with soft soap for half an hour, is strongly rubbed for the same space of time over the whole surface with the sulpho-alkaline ointment of Helmerich, composed of eight parts of lard, two parts of sulphur, and one part of carbonate of potash, and

directly afterwards placed in an alkaline bath. The patient's clothes are fumigated with sulphur.

The objections to this method of treatment are, that eczematous eruptions often follow its employment in persons with a delicate skin, and that the ointment stains the linen. The sulphur ointment of the Pharmacopœia does not cure so rapidly, although it does so quite as certainly as the sulpho-alkaline ointment. The great use of the alkali is to remove the superficial layer of epithelium, and so expose the sarcoptes more completely to the action of the sulphur.

Supposing that, from the position in life of the patient, it is desirable to hide the odour of the sulphur, the best scents for the purpose are the essences of bergamot and of lemons; a little bisulphuret of mercury will conceal the colour of the sulphur.

Devergie recommends, if the odour of the sulphur be highly objectionable, that the patient be placed for an hour, or an hour and a half, daily in a bath containing from two to three drachms of bichloride of mercury. Five or six baths, he says, suffice for the cure. Iodide of potassium may be substituted for the bichloride of mercury, but then more baths are required. Bazin advises, under like circumstances, that the surface be rubbed daily with an ointment composed of powdered chamomile-flowers, lard, and olive oil, in equal parts.

When scabies is present, no matter with what other eruption it is complicated, the scabies is to be first cured, and this although the sulphur cause considerable increase of the complicating affection, *e.g.* eczema.

Diseases of the Hairs.

Porrigo decalvans is very readily recognised. The roots of the hairs atrophy, till at length, being smaller than their follicles, they fall out. Commencing at a point on the hairy scalp, the disease spreads circularly till a bald patch of some size is formed. Now and then the bald patches are irregular in form; still even then the margin of the patch is usually scalloped, as though the large patch had been formed by the coalescence of several smaller patches. The disease may ultimately involve the whole scalp; nay, occasionally the hairs of the eyebrows and the eyelashes are similarly affected, and fall in like manner from their follicles. There is neither redness, heat, tenderness, nor any eruption on the bald patches; usually, indeed, the bald scalp is something paler than natural.

P. decalvans is common enough in children and young persons. It more rarely affects those of more advanced age. The patches from which the hair has fallen are quite smooth. The patches of tinea tonsurans must not be confounded with those of p. decalvans. In the latter the surface of the patch is quite smooth—there is local baldness, and that is all; in the former the hairs look as if they had been cut off just above the point at which they emerge from their follicles.

This disease has been called tinea in deference to the statements of Bazin and others; the writer has never detected any vegetable growth on or in the hairs about to fall from their follicles. The plant, the microsporon Audouini, is said to be found attached to the hairs just above the surface of the scalp. The atrophy of the bulb of the hair is considered to be secondary to the action of the plant.[1] Willan called this disease porrigo decalvans. It is called by some alopecia circumscripta.

Treatment.—If the patient be pale or weakly, iron and cod-liver oil may be given. Local stimulation is, however, far more important. Tincture of iodine is a convenient stimulant; it may be applied night and morning. A saturated solution of sulphurous acid is very efficacious. It should be applied constantly by means of a piece of linen soaked in the solution, and covered with an oil-skin cap. The linen requires to be wetted many times a day. Sometimes the saturated solution of the acid is too stimulating; and if so, it may be diluted with as much or more water—just so much diluted as that it may produce a little redness of the scalp, but no eruption. If the

[1] There is no sufficient evidence that this disease is parasitic; I have never detected any trace of a parasite. It is not contagious, and, moreover, it runs in families like psoriasis.—J. S. B.

patches be small, tincture of iodine is the best application; when the disease is extensive and spreading rapidly, the head should be shaved, and the sulphurous-acid lotion applied. If less powerful stimulants fail, blisters may be applied. As the hair-follicles are seriously at fault, and new hair has to be formed, a cure cannot be quickly effected. The first sign of improvement is the presence of a little downy hair on the patch. This down is, after a time, replaced by better-formed hair, and this again by still more perfect hair. The baldness is rarely permanent.

Plica polonica (*der Weichselzopf*, Germ.)—This is a disease of the scalp which is endemic in Poland, Livonia, some parts of Russia and Tartary, beyond which countries it is scarcely known.

The real nature of this disease is not yet clearly proved. What is visible to the naked eye is a firm matting together of the hairs, and the presence of a sticky material between them. The matted hair sometimes takes the form of a single long tuft, sometimes of several smaller tufts, and sometimes of an irregular mass, forming a kind of cap. The disease is usually confined to the head; but is sometimes met with on the chin, in the axillæ, and on the pubes. There is pain and great tenderness of the scalp, which bleeds on the slightest touch.

It is doubtful what is the source from which the sticky material between the hairs proceeds. Fuchs believed that it came from the hair-follicles; G. Simon regards it as an abnormal secretion from the surface of the skin, not especially implicating the follicles. When it is examined microscopically, it is found to be made up of epidermis, threads of cotton, silk, and wool, with particles of sand, insects, &c. Sometimes, especially in cases of long standing, cryptogamic vegetation is found amongst it. The older writers described the hairs as thickened, swollen at the roots, and infiltrated with sticky reddish or reddish-white fluid. Later writers have not confirmed these observations. G. Simon [1] found no change in the hair, either at the root or in the shaft; it was not brittle or infiltrated with any abnormal material. He could not find, as stated by Günsburg, any vegetation in the hairs themselves.

On chemical examination, the peculiar matter has been found to consist of extractive matters, with ammoniacal compounds, fats, and fatty acids; with some salts, especially chloride of sodium, sulphate, phosphate, lactate, and acetate of soda; with but little potash, magnesia, iron, and silica. These analyses throw no light on the nature of the disease.

It has been suggested by Hebra that plica polonica is not a distinct disease, but eczema, or other skin affection, much neglected. This theory obtains some plausibility from the circumstance that in Poland there is a popular prejudice that this condition of the scalp is a cure for other maladies. On the other hand, it is not confined to the poor and ignorant, and is met with beyond the limits of Poland. T. H.

William Jenner, Thomas Hillier, George Nayler } 1876.[2]
J. S. Bristowe, 1882.

[1] *Die Hautkrankheiten*, p. 388.

[2] The sections of this essay signed G. N. are by Mr. Nayler; those signed T. H. by the late Dr. Hillier; the rest by Sir W. Jenner, except those which are sufficiently distinguished as additions by the present reviser.

LOCAL DISEASES OF THE SKIN.

Corns.

CORNS in their origin are merely local hypertrophies of the epidermis, situated for the most part on the feet, occasionally upon the hands, and more rarely over the prominences of the elbows or knees.[1] They are produced by intermittent pressure or friction, localised either by the natural prominence of the part affected, or by the peculiarities of the exciting cause.

Thus, on the feet they are produced by the irritation of ill-fitting boots. These, either from being too small, subject the most prominent points on the foot to undue pressure, or more generally, from being misshapen or too large, chafe and irritate the feet in walking. The peculiar distortion of the toes occasioned by short shoes—namely, the extreme contraction of the flexor tendons, the doubling-under of the extremities of the toes, and the dislocation of their phalanges on the dorsal aspect—predisposes to the formation of corns. Arising from this cause, they usually occur on the flat ends of the toes which press downwards against the sole of the boot; or on the dorsal surface of one of the phalangeal joints, which, being unnaturally prominent, are thereby exposed to friction against the upper-leather. In a less degree, tight stockings are a cause of corns by crowding the toes and hindering the even spread of the foot in walking. On the hands these growths may occur upon the palms or upon the knuckles; they may be produced by the friction of the thimble in tailors and sempstresses. In such as play upon the harp and violoncello they are often found on the palmar surface of the finger-ends and thumb; and more rarely the friction of the pen in writing will be sufficient to produce them on the second finger or thumb. Again, the peculiarities of certain manual occupations may excite their growth upon the prominences of the knees or elbows.

From the occurrence of corns in very young children as soon as they begin to walk, and from their prevalence in certain families where both parents are sufferers, it cannot be doubted that a predisposition to their growth may be communicated by hereditary transmission. As has been mentioned above, intermittent and frequently repeated irritation, by friction or pressure of a *certain degree*, is required for the production of a corn. This acts by stimulating the cutis to the formation of an undue amount of epithelium, forming the characteristic thickening of the cuticle. Should the irritation, however, be excessive, either in its degree or its duration, effusion of serum between the cutis and cuticle takes place, and a blister instead of a corn results.

Corns may be broadly classed under the terms *hard* and *soft*. The hard may be either flat and horizontally laminated in their structure, or fibrous and vertical in the arrangement of their parts. Again, in various stages of their development corns differ in their connections with surrounding tissues.

If a hard flat corn be examined in its earliest condition, it will be found to consist of a simple thickening of the cuticle, not well defined in extent, in shape somewhat like the flat head of a nail, and composed of epithelial scales, condensed, and having a regular horizontal lamination in their arrangement. By maceration such a corn may be completely separated from the cutis, leaving the subjacent papillæ distinct and well defined, and in no way altered from their normal condition. In its further progress the growth becomes more clearly circumscribed, and, increasing in thickness, produces greater pressure on the parts beneath. In old-established corns,

[1] A case is related of a corn occurring on the tongue at King's College Hospital, under Mr. Hulke's care. *Med. Times and Gazette*, 1861, p. 556.

situated over the phalangeal joints of the toes or some other prominent point of bone, this pressure and continued irritation generally gives rise to the formation of a bursa beneath, though the occurrence of a subjacent bursa is by no means an invariable consequence.

From the examination of corns that have evidently existed many years, and have from time to time been subjected to treatment, it appears that the long-continued pressure and frequent removal of the upper layers of the cuticle may at length lead to complete absorption of the papillary structure of the skin. Such corns may be found based upon the fibrous tissue of the sheaths of the extensor tendons of the toes, all intermediate structures having been absorbed.[1]

The progress of corns, the pain they occasion, and their ultimate result, differ with the varying intensity of their exciting cause, and with the different plans of treatment adopted for their cure. Thus, excessive irritation from pressure or other causes may excite inflammation and suppuration in the cellular tissue or bursa which often lies beneath. The matter in these cases generally finds exit by bursting, the thickened epithelium may scale off, and a cure result; or the matter, before bursting externally, may find its way into one of the phalangeal joints, giving rise to a small but troublesome perforation of the articulation. Occasionally the suppuration of a corn, its bursting, and the consequent exposure of the deeper parts, will lead to loss of one of the phalanges by necrosis. Some time since there was in the wards of St. Bartholomew's Hospital a patient who, from a perforating ulcer originating in a corn, had lost by necrosis the first phalanx of the little toe, together with the distal end of the corresponding metatarsal bone.

Treatment, when not followed by cure, may modify the progress of the disease, by exciting in some cases inflammation, ulceration, or sloughing of the part; such effects being for the most part caused by the application of various escharotics. The ordinary practice of chiropodists—namely, that of cutting out the centre of the corn deeply, leaving the circumferential part, and protecting the centre from pressure by properly adapted plasters—often produces a change in the structural arrangement of the growth. Thus, the central hole may become filled up by what is termed a fibrous corn—*i.e.* a corn with a vertical arrangement of its epithelium, which ensheaths a few elongated and sensitive papillæ. By maceration the two parts of the corn may easily be separated; the vertical or fibrous portion coming out like a plug, and leaving a clean hole in the surrounding laminated and thickened epithelium. Another effect of frequent cutting is the permanent depression of the centre of the corn considerably below the level of the surrounding skin, and coincidently with this change there is absorption of the cutaneous papillæ.

The common pearly yellow hue of corns is due to simple condensation of the epithelium. Occasionally minute hæmorrhages take place into their substance, either from some unusual irritation of the cutaneous papillæ, or by injury to their extremities by cutting, or in attempts to extract the corn. The centre of the growth may thus acquire a bluish-black tint, popularly supposed to be the root of the corn, and upon the extraction of which the professed corn-cutter specially prides himself.

Fibrous corns.—These might more properly be called warts, since in them the papillary structure of the skin predominates. They consist generally of a few elongated papillæ ensheathed by epithelium, rough on the surface, and more sensitive to pressure than the ordinary corn. They are situated for the most part on the balls of the toes or soles of the foot, rather than on the dorsal aspects of the phalanges; nor have they, in such specimens as the writer has examined, any underlying bursa.

Soft corns are found generally between the toes, and most frequently upon the fourth toe, on one or other of its lateral aspects. They differ from hard corns in being more sensitive and vascular, in the greater rapidity of their growth, and in many of them possessing a pretty distinctly papillary structure. The constant moisture to which they are exposed from their position causes them to be spongy and condylomatous in their appearance. Indeed, many that pass under the name of soft corns

[1] Cruveilhier, in tom. iii. p. 927 of his *Pathological Anatomy*, says he has never seen the corn penetrate the subjacent articulation.

upon the feet would, if found in the neighbourhood of the anus, be recognised as condylomata. Not a few have broadly overhanging edges overlying the sound skin around, seemingly the effect of pressure upon their soft and spongy texture. Occasionally a bursa is found beneath them.

These corns are liable to the same accidents as the harder variety; they may inflame, ulcerate, or suppuration may take place in the bursa or subcutaneous tissue beneath them, giving rise generally to a minute central aperture through which a serous fluid oozes for long after the escape of the matter.

In addition to the ordinary and most obvious inconvenience attached to corns—namely, pain, increased by warm or moist weather, and generally most annoying during the spring-time—there are the more serious evils of suppuration and ulceration; the latter being generally a sequence of the former, or in some cases resulting from the indiscreet application of caustic irritants to the corn. In patients with languid or deficient circulation, where, either from want of power in the heart or from disease of the arteries of the limb, the standard of nutrition is too low to resist the ulcerative process, the ulcer may form the starting-point of a slowly progressive gangrene.

Less obviously, though not less certainly connected with these growths, are many cases of lateral curvature of the spine; generally commencing in early life, and taking their origin from a habit of throwing the weight of the body in walking to one side, in order to relieve the pain of a corn on the opposite foot. Among the same class are rare instances of cramped and difficult action of the muscles of the leg and foot, which may excite suspicions of a failure in the nervous energy of the patient, but are really due to the habitually constrained movement of the limb in the attempt to 'favour' a painful corn.

Treatment.—Hard corns in their earliest stage will often disappear if the irritation that produced them be removed, and this may generally be traced to the wearing loose, ill-fitting, or patent-leather boots, or it may be simply to the habit of wearing the same boots many days in succession. The application of a drop or two of glacial acetic acid with a camel-hair brush every night will disorganise the cuticle, which may then be picked off with the point of a knife or scissors, or the corn may be rubbed down with a corn-file. The cuticle may be softened for rubbing down by the application of lint steeped in a solution of carbonate of soda, and covered with oiled silk. It is well, after the removal of a corn in the foregoing manner, to protect the part for a time by wearing over it a small patch of soap-plaster spread on wash-leather.

When, from a day of unusual exertion, or from any other cause, a corn becomes inflamed or more than ordinarily painful, it may be covered at night-time with a small patch of wet lint with oiled-silk over it; this both relieves the pain and gives an opportunity in the morning for removing the growth entirely.

The use of nitrate of silver in substance is strongly recommended by some surgeons; it should be applied after the thickened epithelium has been pared down, or, better, picked off; the scale of blackened cuticle which it produces is said to separate in a few days, leaving a smooth and healthy surface, if the corn has not penetrated too deeply. Some discretion must be exercised both as to the condition of the corn (whether inflamed or otherwise) and as to the extent to which this remedy is applied; its injudicious use may produce considerable suffering.

Old-established hard corns are seldom cured, since the patient is unwilling to submit to the restraint and inconvenience of the necessary treatment. Occasionally an illness which confines the sufferer to bed for some time rids him of his corns, or they may disappear in the desquamation following scarlatina.

It is notorious that, as the expression is, those who 'attend to their corns' suffer but little inconvenience from them; while among those who suffer most are such as visit chiropodists at prolonged intervals and purchase for themselves a few weeks of ease at the cost of as many more of suffering. In the treatment of old-established hard corns it may be well first to soften the cuticle by the application of wet lint and oiled silk during some hours; when it is soft and pulpy an incision may be

made with a small sharp knife completely surrounding the centre of the growth, or the same incision may be effected with a succession of snips with the points of a pair of scissors. Having completely circumscribed the corn, its centre may be raised with a fine hook or a pair of forceps, and the included piece may be removed by cutting under its base; each incision being of small extent, or it will cause pain. The margins of the opening left by the removal of the corn may be slightly bevelled off, and a plaster applied made of soft thick buckskin or amadou spread with adhesive material; a hole being cut in the plaster corresponding with the extent of the corn, and the outside margins of the plaster being bevelled off with a sharp knife.

If it be thought sufficient to protect the corn from pressure without previously removing any of its substance, the centre of the growth may (as recommended by Sir B. Brodie) be covered with a piece of linen rag or thin diachylon to prevent it bulging through the hole in the corn-plaster.

Suppuration beneath a corn may be recognised by the intense pain and throbbing of the part; it should be relieved as soon as possible by puncture, the cuticle being previously softened by the application of warm-water dressing. In favourable cases where the circulation in the foot is healthy and vigorous, the opening of an abscess beneath a corn is frequently followed by complete disappearance of the growth; in others, either from general debility or local deficiency in the circulation, this perforation gives rise to a chronic and intractable form of ulcer. Such a sore is best treated by invigorating constitutional remedies; and among these, opium in small doses is generally most effective; locally some stimulating application, such as resin-cerate or turpentine ointment, may be used with advantage.

Soft corns seem to owe their existence to the friction of one toe against its neighbour, and their more rapid growth to the warmth and moisture of the locality where they are for the most part found. Unless in a state of inflammation, these corns may generally be cured by the application of the oxide of zinc in powder, or equal parts of this and the pulvis æruginis may be dusted over the growth, and the toe be surrounded with a thin wrapping of cotton-wool; after a few applications the corn will either dry up and disappear of itself, or its shrivelled remains may be cut away without pain or inconvenience. The application of the glacial acetic acid will be found very useful in the treatment of soft corns. But, whatever plan be adopted for the cure of the disease, the affected toe should be kept apart from the others by the daily application of cotton-wool.

There are certain corns which, from their situation and cause, require a separate mode of treatment; such are those arising from contraction of the flexor tendons, with doubling-under of the ends of the toes and unnatural prominence of the phalangeal joints on their dorsal aspect. The corns from this cause are situated either on the extremity of the toe or on one of the joints on the dorsal surface. In these cases the toes must be straightened, either by strapping the toe or toes to a gutta-percha splint placed on the plantar surface, by division of the flexor tendon, or by winding a piece of linen rag or adhesive plaster over the dorsum of the prominent toe and beneath the toes on either side.

Those whose feet are habitually predisposed to corns, or who suffer serious inconvenience either from the number or pain of these growths, should wear boots made from some other material than leather. As a substitute for leather nothing is so good as the invention that rejoices in the classical but ungrammatical name of *pannus corium*. This, from its softness and pliability, is particularly suited to tender and irritable feet. Persons liable to corns should carefully avoid wearing patent-leather boots, as hindering the escape of the cutaneous transpiration.

Bunions.

The term 'bunion' is applied to enlarged bursæ situated on any part of the tarsus, metatarsus, or phalanges of the toes; but for the most part placed over the metatarsal joint of either the first or fifth toe, and accompanied with more or less distortion of the subjacent articulation.

To study rightly the exciting cause of this disease, it may be well to revert for a moment to the natural form of the foot uninfluenced by the distortion produced by modern boots and shoes. Perfectly formed feet may be seen in the many shoeless children of the London streets. If such be examined, it will be found that, as regards general conformation, the foot is widely spread towards the toes, that the inner line of the foot and great toe is nearly straight, or, as Professor H. Meyer more accurately expresses it,[1] the central longitudinal axis of the great toe carried backwards passes through the centre of the heel. There should be moreover a considerable interval between the first and second toes along the whole of their contiguous margins; the second and third toes are also separated, though by a narrower interval; nor do the third and fourth toes touch each other when the weight of the body is borne on the foot.

Comparing with this the foot of an adult that has been distorted by the purely conventional shape of modern boots or shoes, we may observe, first, that, from lateral pressure and crowding, all the toes are in close contact with each other, and not infrequently the second or third toe overrides or is doubled under its neighbours, or the little toe is doubled under the fourth toe so that on the dorsal aspect of the foot its root is but just visible. From the same cause the toes all incline towards the middle line of the foot; this distortion particularly affecting the great toe, which, instead of remaining in a right line with its own metatarsal bone, turns obliquely away towards the outer side of the foot; so that if the line of its longitudinal axis be carried backwards, it would fall altogether to the inner side of the heel.

The above-mentioned distortions are easily accounted for by the narrowness of the sole of modern boots, which crushes up the toes into a bunch, and the sloping of the inner side of the boot towards the middle line of the foot thus constantly exercising pressure on the inner side of the great toe and thrusting it over towards the outer side of the foot. Boots, again, very generally by their shortness press on the end of the same toe, pushing it directly backwards, thereby increasing its distortion from the right line, and this, by bearing on the head of the corresponding metatarsal bone, causes the latter to project on the inner side of the foot. In addition to the direct effect produced by the pressure of misshapen boots, the material of which the boot is made may exercise a predisposing influence on the formation of bunion; patent-leather, as it is called, or any material which, like it, completely stops the evaporation of the transpiration from the cutaneous surface, has this effect.

There exists undoubtedly in many persons an hereditary tendency to the formation of bunions, a predisposition in which even the most carefully constructed boots will fail in averting the formation of these cysts.

Though generally situated over the first joint of the great toe, as the part exposed to greatest irritation, yet it is by no means rare to find bunions developed over the prominence of the scaphoid bone, or, again, on the outer side of the foot over the proximal or distal end of the fifth metatarsal bone, and elsewhere on the dorsum of the foot over any prominences where the natural conformation of the part fails to correspond with the artificial and arbitrary shape of the shoe.[2]

[1] *Procrustes ante Portas*, by H. Meyer, translated by J. S. Craig, Edinburgh.

[2] Through the kindness of Mr. E. James, of the Melbourne Hospital, we are enabled to quote the following remarks of Dr. George Bennett, of Sydney, in answer to an inquiry by the writer of this article:—

'Sydney, March 1881.

'With respect to the distortion of the feet of the natives of this country, I have observed neither in the aborigines of Australia, nor among the natives of the Polynesian Islands I have visited, any of the distortions you allude to as seen on the feet of the civilised races who encase them in shoe-leather. Nor have I seen among the natives corns or bunions.'

In its early formation, a bunion generally attracts attention as a painful and tender spot over one of the metatarso-phalangeal joints previously exposed to pressure and irritation by distortion of the corresponding toe. By-and-by, the part enlarges, indicating an effusion into an already existing bursa,[1] or the formation of an adventitious synovial cyst. This effusion, though the result of inflammation, is generally recognised as designed to protect the subjacent parts from pressure. At this point the disease may cease to make progress; the bursa may remain; and may effect the object to which we have just alluded, occasionally reminding the possessor of its existence by a passing twinge of pain. Far more frequently the bursa, though an efficient protection, reserves to itself the irritation it wards off from the joint beneath; the consequences of this are seen in repeated attacks of pain or inflammation, causing progressive enlargement; or it may be in the formation of callosities or corns on its surface, or in suppuration of the contents of the cyst. The evacuation of the fluid from the interior may be followed by obliteration of the cavity and cure of the disease; but in old people, or in those of languid circulation, it may give rise to a most troublesome form of ulcer.

The perforating ulcer of a bunion has for the most part a pallid indolent appearance, and secretes a pretty abundant sero-purulent discharge. If a probe be introduced, it will generally be found that the size of the external orifice bears no proportion to the cavity of the sore, which latter is relatively very large, and extends some distance beneath the margins of the ulcer; occasionally there is a fistulous passage from the bottom of the sore communicating with the joint beneath.[2]

Coincidently with the distortion of the joint, which precedes or accompanies the formation of a bunion over the base of the great toe, there are changes to be observed in the conformation of the articular ends of the bones, in the cartilage, ligaments, and tendons, in connection with the joint. The head of the metatarsal bone enlarges, and is often encircled at its margin by bony deposits; the articular cartilage is almost invariably absorbed, and the bone beneath eburnated. The internal lateral ligament is elongated; and the external so shortened that, if in the dead body an attempt be made to restore the toe to its natural position, this ligament tears. The extensor tendon of the great toe is located to the outer side to a greater or less extent, and in extreme cases the sesamoid bones will be found to have shared in the general displacement, being dislocated with the phalanges of the toes towards the outer side of the foot.

It may be questioned whether these changes in the joint, which are analogous to those occasioned by chronic rheumatic arthritis, are directly the effect of the distortion, or whether they are not rather occasioned by that disease occurring in the joint in question as the 'locus minoris resistentiæ,' as it has been called. This is the more probable from the known tendency of gout to attack the same joint, and it may be for the same reason.

Treatment.—It is only in the early stage of bunion that treatment will avail for the complete removal of the disease, though palliative measures are practicable at all times.

The tender spot that precedes the formation of a bunion may be advantageously covered by night with wet lint and oiled-silk, while by day a more commodious boot than usual should be worn to free the part from pressure, care being taken that the boot or shoe be wide in the sole, and not sloped off on the inner side towards the median line of the foot. If the part be very tender, it may be covered during the day with soap-plaster spread upon kid or wash-leather.

So soon as a cyst has formed, in addition to the above-mentioned precautions, means should be taken to procure the absorption of its contents, either by the occasional application of strong tincture of iodine, or the continual application of the compound mercurial cerate upon linen rag, the margins of the swelling being protected with some soft plaster. For the cure of bunions when uninflamed, and for such as have much fluid within them, we have found an ointmont of biniodide of mercury

[1] For an exhaustive enumeration of natural bursæ, see Schreger, *De Bursis mucosis subcut meis.*

[2] This affection is the 'mal perforant du pied' of French authors.

most useful; it should be applied occasionally, or at least not so constantly as to blister the skin. The strength we would recommend for this purpose is ten grains of the salt to an ounce of lard.

On the occurrence of inflammation in the sac of a bunion from any cause, water-dressing, or a poultice, will be found the most comfortable application. A careful watch should be kept for any sign of suppuration, since, should it occur, an early and free incision is both requisite for the relief of pain, and is often followed by the complete cure of the disease. It is often the habit of persons suffering from severe bunion and distortion of the toes, to wear boots made to fit accurately their distorted feet. Professor Meyer recommends in such cases the wearing of a shoe so constructed as to tend to restore the toes to their natural position. He says, 'the sole should be cut exactly as if the toe were in its proper position;' questioning, however—and we think with reason—how far such an expedient would be advisable in cases of very extreme distortion of the joints, or prominence of the enlarged bursæ.

The difficulty of healing the ulcer resulting from the bursting of a bunion is sometimes very great, especially in old people, or in those whose circulation is languid from other causes. A stimulant local application, such as the resin or turpentine-cerate, will generally be found useful; while the use of opium and stimulants internally, with easily assimilable and nutritious diet, is called for. If, as is generally the case, the ulcer have a small external orifice and deeply undermined and overhanging edges, they should either be destroyed by caustic, or they may be laid open by a crucial incision, or be removed entirely by scissors. Under the most judicious treatment, however, these ulcers, in persons of feeble circulatory powers, or where the arteries of the part are extensively diseased, may form the starting-point for senile gangrene.

Some surgeons have remedied the deformity of the first toe mentioned above by removing the outgrowth from the end of the metatarsal bone. The toe can then be restored to its natural position. Such an 'operation of convenience' should be performed with the strictest antiseptic precautions.

Warts.

Warts, or verrucæ, are collections of overgrown cutaneous papillæ, either completely ensheathed by an excessive formation of scaly epithelium, or each papilla of the growth stands beside its fellow, separate, having only its natural cuticular sheath.

Verruca simplex, the most common form of wart, consists of a bundle of hypertrophied papillæ, closely adherent, and ensheathed by a thick covering of cuticle; from friction and exposure to the air its surface is generally horny in texture, and is rounded off into a small button-like protuberance. This species of wart is found solitary or in large numbers, chiefly in young persons, and is situated most usually about the hands or fingers, occasionally on the face, and more rarely on other parts of the body.[1]

Verruca digitata is a name applied to a less common variety of wart, situated almost invariably on the hairy scalp. On examination, it will be found to be formed of a few cutaneous papillæ imperfectly ensheathed by cuticle. This wart is more pedunculated in its attachment to the surface than the foregoing variety; its papillæ are long, and often free at their extremities, giving the surface of the growth a ragged appearance. It is found, as stated above, generally on the scalp, and so far as one's own experience extends, only in women after adult age:[2] such warts, either from their number or from some unfortunate peculiarity in the position of a single growth, may give rise to great pain and inconvenience in brushing or combing the hair.

Subungual warts.—Warts very similar in structure to the foregoing occasionally form beneath or at the side of the finger or toe-nails. Situated here, they are gene-

[1] A case is related of a wart of this kind occurring on the tongue, *Medical Times and Gazette*, 1861, p. 556.

[2] I have seen them more than once in men, in one instance occurring in considerable numbers.—R. J. G.

rally softer in texture and more rapid in growth than those on the scalp. They originate beneath the nail from the sensitive skin to which the nail is attached, between its free margin and the *real* matrix; and in their further growth they generally crop out either at the free extremity or lateral margin of the nail. Such are apt to be very painful and inconvenient.

Verruca confluens is a term introduced by Mr. Erasmus Wilson to designate a variety of warts found on various parts of the body, chiefly over the neck and upper part of the thorax, or the backs of the hands or arms. The growth in question consists of an aggregation of closely packed but distinct papillæ, often smooth on its surface, and without any evident indication of the isolation of its component papillæ; but on pinching up the skin of the part its surface will break up into minute fissures showing its papillary structure, which bears a resemblance, in M. Rayer's opinion, to coarse plush.

These growths are of uncertain size and shape; they may occur in patches or irregular bands. Either spontaneously, or more generally under some local irritation, they may extend pretty rapidly over the surrounding skin; their advance in any direction being usually preceded by the enlargement, here and there, of outlying and isolated cutaneous papillæ.

Differing in some respects from ordinary warts are those of venereal origin. Such are more vascular in their structure, are often of fleshy consistence, and pedunculated in their attachment to the surface. If those that have existed some time be examined microscopically, their bases will be found to include portions of the structure of the deeper layers of the skin; namely, a dense network of areolar tissue and more thinly scattered elastic fibres: in this particular they resemble old condylomata, and in this they differ from common warts, which consist only of papillæ and their epithelial covering. Venereal warts often have comparatively large blood-vessels entering their under surface. Such warts, from the warmth and moisture of their position, situated (as they usually are) beneath the foreskin or between the labia, grow more rapidly, and attain a larger size than other varieties, propagating themselves abundantly by contact with neighbouring parts.[1]

Causes.—Though occasionally congenital in their origin, warts are notoriously capricious in their appearance, period of duration, and disappearance. Some individuals exhibit an hereditary tendency to their formation, and not a few are affected with warts corresponding in position to those existing in one of their parents.

Mr. Sedgwick gives an account of a family under his observation, where warts on the hands have been hereditarily limited to the female line for two generations. The mother herself was much troubled with numerous warts on her hands, which appeared in infancy, continued through childhood, and disappeared soon after puberty. She had five children: a boy aged 11, a girl aged 9, a girl aged 7, a boy aged 5, and a girl aged two and a half. The two boys never had a wart; the three girls are all troubled with them—the eldest has thirty warts, the next daughter has twenty-four on the hands. In both, the warts appeared in infancy, and have increased in number since. The youngest child has two warts at present.[2]

The period of life between infancy and puberty seems particularly that in which warts grow most luxuriantly. Verrucæ may suddenly appear either singly or in large numbers; such eruptions generally attacking the hands and wrists; they may remain a longer or shorter time, and as rapidly and unaccountably clear off.

Adults but rarely suffer in this way, though we recently observed a very copious eruption of warts over one side of the neck and upper part of the chest in a lady about forty years of age. They were very numerous, and a few weeks had elapsed since she noticed their commencement; they varied greatly in size, some being just visible, while others were as large as swan-shot. More recently a professional friend showed me a large crop of common warts of various sizes, which had appeared without apparent cause upon his own hands, none of them having existed more than four or five weeks.

The irritation produced by certain discharges, especially by such as are of a venereal origin, is a well-known and generally acknowledged cause of one form of

[1] We have seen in a child warts precisely similar in appearance to the venereal, growing from the commissure of the lips, and lying within them when the mouth was closed.

[2] *Brit. and For. Med.-Chir. Rev.* April 1853.

wart; and no less certain is the occasional effect of soot in the production of the malignant wart of chimney-sweepers.

From the frequent occurrence of distinct warts, or warty thickenings, upon the hands of persons occupied in post-mortem investigations, or in the study of practical anatomy, it is more than probable that the poison of decomposing animal matter, under certain conditions, is capable of exciting the formation of these growths. At all events, one's personal experience, and that of many of our pathologists and demonstrators of anatomy, lends support to this opinion. Cadaveric warts have a somewhat special appearance; they are broad-based and flat, and generally the seat of more or less inflammation. In many cases suppuration occurs beneath such a wart, the pus discharging itself by numerous minute openings upon the surface.

Some warts are undoubtedly contagious, and especially those of venereal origin, and such as occur from other causes about the genital organs; next to these in their aptitude to spread by contact are such as occur in crops about the hands.

It is a popular belief that the blood from a wart is capable of reproducing others when applied to the external surface of the body; and a case has recently appeared in the French journals tending to confirm the popular prejudice. M. Cruveilhier states that M. Banuel showed him a band of warts upon the back of the hand, assuring him that they had sprung up in the line of the stream of blood flowing from one of these growths during its removal.[1] But M. Rayer states that 'he has repeatedly tried to inoculate warts in this manner, but the operation has never succeeded.'[2] Unintentionally one has several times performed the same experiment, and always with a negative result.[3] As one would suppose, such warts as furnish a secretion from their surface manifest most decidedly their contagious character; but that this peculiarity is not confined to such, I may refer to a case related to me by Sir James Paget, where an individual with a small and completely dry wart on the foreskin, which had existed for some years, and who had suffered from no venereal affection within many years, married, and communicated to his wife a most abundant crop of warts, which affected the labia and parts about. She in the meantime suffered from no discharge, either leucorrhœal or gonorrhœal. The original wart in the husband underwent no change either in size or appearance, nor did it furnish any palpable secretion.

Progress.—The capricious and sudden disappearance of warts has given rise to a belief in the efficacy of charms for their removal. But it is rare for any but the common wart that affects the hands of young people to disappear in this way; and this may account for the fact that wart-charms have but little reputation for the cure of these growths when of venereal origin.

The common wart of the external integument may remain for many years, or a lifetime, without materially increasing in size; its growth, however, may be stimulated by some permanent source of local irritation; indeed, warts that in their commencement differ in no recognisable feature from the verruca simplex, may in their subsequent progress assume a character in no way distinguishable from epithelial carcinoma; such are usually situated on the face. For an interesting and detailed account of the structural changes occurring in their degenerations, the reader is referred to a paper by Dr. Collis in the 'Dublin Quarterly Journal' for May 1860.

The production of horns by the excessive growth of warts, with the dessication of their external layers of cuticle, will be considered under the head of 'Horns.'

Treatment.—Warts that are dry in their texture and but scantily supplied with blood, such as the verruca simplex and the scalp-wart, may generally be easily removed by some chemical solvent; perhaps one of the most efficacious and manageable of these is the glacial acetic acid; it also has the advantage of being painless in its action. It may be applied with a camel-hair brush to the wart until its texture is pretty thoroughly sodden with the acid, care being taken to prevent the blistering of the skin in the neighbourhood; the application may have to be repeated once or twice. Nitrate of silver in substance is a popular but unsightly remedy. Tincture of the perchloride of iron is generally effectual, but it is better suited for the cure of warts that are moist and secreting. The application of a drop of the strong nitric acid, or

[1] *Anatomie path. générale*, tom. iii. p. 926.

[2] Rayer, *On Diseases of the Skin*, p. 982.

[3] I am acquainted with a gentleman who intentionally performed the same experiment, and with apparent success; a wart forming on the back of the hand where the blood was applied.

acid nitrate of mercury, is exceedingly efficacious, and causes less pain than is generally supposed.

Vascular pedunculated warts of venereal origin may be removed at once by the knife or curved scissors; or if too vascular or bulky for this remedy, the application of some drying powder, such as the oxide of zinc, or equal parts of this and the diacetate of copper, or a mixture of equal parts of powdered savine and diacetate of copper; any of these constantly applied will either remove the growths entirely, or bring them into such a condition that they may be safely removed by the knife. Some discretion must be exercised in applying the knife to large crops of warts of long standing or considerable size, situated upon either the glans penis or internal labia, as troublesome or even dangerous hæmorrhage may occur; of this, examples not infrequently occur in the venereal wards of our hospitals. In my own experience I have been compelled on one occasion to apply the actual cautery to the glans penis to arrest the hæmorrhage caused by the removal of a mass of verrucous growths; the bleeding in this case was most formidable in quantity, and quite uncontrollable by other means used for its suppression. In many cases of bulky pedunculated and vascular warty masses, such as affect the external genitals of women, and more rarely those of men, the écraseur of Chassaignac will be found a convenient and safe instrument for removing the disease; or they may readily be cut away by means of the *thermo-cautère*. The warty thickenings that occur on the hands from the contact of post-mortem fluids may be treated by the free application of acid nitrate of mercury,[1] or they will slowly disappear if protected from friction. An ingenious method has been devised by the late Mr. Nesbitt, of Wolverhampton, for the removal of pedunculated warts by the application of an elastic ligature. A thin india-rubber thread, much as may be drawn out from an old brace, or a small elastic ring, is applied to the base of the growth, so as to constrict it pretty tightly, though not painfully. In a few days the wart will generally dry up and fall off.

For the cure of congenital warty growths which affect large portions of the skin, and for those described under the term 'verruca confluens,' the free application of the strong nitric acid is necessary; or the growth, if small, may be excised with the portion of skin upon which it is based. Occasionally it is advisable, in order to avoid loss of the integument, to shave off the papillæ composing the wart with a sharp knife, and to brush the surface over lightly with nitric acid.

The most effectual and speedy cure of warts is by excision of the growth itself, together with the integument upon which it grows; and this is the safest manner of treatment for rapidly growing or degenerating growths, or any which excite a suspicion of a malignant character.

From the situation of subungual warts upon the fingers or toes it is difficult to apply caustics, or to remove the disease by excision; where this is the case, the papillæ composing the growth may be pulled out separately by means of the forceps —a proceeding easy of execution, and causing but little pain.

Horns.

Differing but little in their elementary composition from warts, horns, by their different structural arrangement, and by the greater exuberance of their growth, present but little external resemblance to these growths. True horns consist of scaly epithelium, more or less condensed and dessicated, for the most part containing within them a fibrous-looking papillary core derived from the true skin, and consisting of extremely hypertrophied papillæ, each thickly ensheathed and separated from its fellow by a condensed cuticular covering. These are supplied freely at their base with blood-vessels, which penetrate some distance up the centre of each. They form the matrix from which layers of cuticle are continually being formed and pushed onwards.[2] Such horns may be called 'papillary.' They are marked

[1] This, however, is a very painful application. In my experience fuming nitric acid, or even sometimes excision, are less painful and more efficacious methods of dealing with them. In some belladonna and glycerine will effect a cure.—R. J. G.

[2] For a good description of the minute structure of these horns, see a paper on human horns by Mr. A. M. Edwards, *Edin. Med. Journal*, November 1859.

externally by longitudinal lines, are rough and fibrous-looking, and generally taper towards their ends, their free extremity being often finely pointed. As might be supposed from the large growing surface presented by the papillary core, these horns are often very rapid in their growth, and attain to a larger size than any other variety. They grow generally from the free surface of the skin, being immediately connected with it.

Another type upon which horns are formed is where they grow from a vascular matrix, flat, or very slightly projecting beyond the level of the skin, and sending no prolongations into the interior of the horn itself, which in this case is formed entirely of epidermis in various stages of condensation. These horns are generally marked by annular constrictions at pretty regular intervals; they have a tendency to curve or become spiral, and bear, for the most part, a greater resemblance to the horns of the smaller ruminants than the papillary variety.

These horns, moreover, from the more horizontal lamination of their component parts, more readily break off and more easily crack transversely; while the papillary horns, from their fibrous arrangement, split longitudinally at their extremities, but break off with difficulty. Perhaps the best examples of the former description of horn are met with growing from the matrix of the toe-nails, or from the interior of sebaceous cysts, where, indeed, they attain their largest dimensions.[1]

There is in the Museum of the Royal College of Surgeons an anomalous specimen of a horn formed of compact bone, ensheathed by a covering of horny matter; the bone within the horn apparently has no continuity of tissue with the skull. The parentage of this growth seems to be uncertain, since it is described in the catalogue as '*supposed* to be an excrescence from a human scalp.' Bony projections from the exterior of the skull, having the external appearance of horns, but being connected with the bones of the skull, are not true horns but exostoses, and are generally of the variety termed 'ivory.'

From tabulated accounts of cases of horny growths,[2] it appears that out of 151 cases, 81 occurred in females, and 70 in the opposite sex. From the same tables one may gather the comparative liability of certain regions of the body to these growths. Thus, of 142 cases, 63 grew from the head; 32 from some part of the lower limb; 23 from the trunk, on one or other of its aspects; 16 from the face; and 8 from the glans penis. In addition to these, we may take into consideration horns growing from the toe-nails, which are by no means rare among those old women of the poorer classes who jealously guard their feet from the contact of water.

Origin of horns.—A generally acknowledged and common source of human horns is from the interior of sebaceous cysts, such as frequently affect the hairy scalp. They may arise from the interior of an unruptured cyst, and bursting through the cyst-wall may continue their growth external to it; but far more frequently the horn takes its origin from the secreting surface of a cyst that has either burst spontaneously or been accidentally ruptured. Such may grow with extreme rapidity, the exposure to the external air having the double effect of stimulating the increased secretion of epithelial matter, and of rapidly drying that already formed to a horny consistence.

A growth, differing in its structure in no material particular from the horns of sebaceous origin, is often found growing from the matrix of one of the toe-nails, being most frequently situated on the great toe. They may be found from one to four inches in length, tapering at the point, and often curved spirally like a ram's-horn. In these growths, the layers of epithelium forming the nail, instead of lying, as is natural, parallel to the long axis of the phalanx, lose their horizontal arrangement, and, becoming more vertical, turn upwards as they are pushed forwards from below by the growing matrix.[3] The exterior of these horns is dense and partially

[1] For an excellent description of the structure and manner of growth of this variety of horn, the reader is referred to Mr. Erasmus Wilson's work on *Diseases of the Skin*, p. 621.

[2] Erasmus Wilson's *Diseases of the Skin*, p. 624; where also is a reference to a paper by M. Lozes in *Mém. de l'Académie royale de Médecine*, June 1830.

[3] A good example of such a growth is seen in St. Bartholomew's Hospital Museum, series xxvii. species 24.

translucent, having the appearance and consistence of horn; the interior is composed of epithelium, less condensed, and easily separable into layers. Cruveilhier considers that the pressure of the bed-clothes in old and bed-ridden people gives rise to these growths by irritating the matrix of the nail. The best specimens that I have seen of this form of horn have been among old women who have presented themselves as out-patients, in whom, therefore, this cause could not have been in operation. Moreover, it may be generally observed that these horns turn outwards, lying over the tops of the other toes, their direction being influenced by the shape and dimensions of the shoe.

The papillary horns, as they are called, in their commencement differ but little from some of the dry kinds of wart; indeed, it is more than likely that many of these growths are of warty origin. Mr. Erasmus Wilson denies the possibility of this mode of origin, in opposition to Cruveilhier.

In the College of Surgeons Museum is a specimen 'of a horny growth from a wart on the hand.' It is about three inches or more in length, about an inch in diameter at its base, and has a longitudinally fibrous structure; it is an undoubted horn. I myself removed a small horn, about half an inch in length, attached to the integument of the neck, from a woman in whom I had the opportunity of watching its origin in the form of a small wart.

Horns are occasionally found in connection with epithelial cancer, and generally grow from the thickened and tuberculated skin at the margin of the cancerous ulcer. Cruveilhier cites a case of this kind connected with the lower lip. A patient presented himself at St. Bartholomew's Hospital with a recurrent epithelial cancer of the heel, connected with which was a horny growth in the form of a large flat boss, which on removal proved to be true horn.[1] Analogous to horny formations of this kind are such as are occasionally met with in the keloid disease of cicatrices, and in chimney-sweeps, connected with cancerous warts.

Treatment.—The only efficient treatment for these growths is by complete removal, together with the portion of the skin upon which they are based; or, if springing from the interior of a sebaceous cyst, the whole of the cyst should be dissected out. Such as grow from the matrix of the toe-nails are best removed by a fine saw, if too dense for the knife; the nail being subsequently pared away to its proper shape and dimensions. Any subsequent tendency to exuberant growth from the same part can be checked by the application of the glacial acetic acid, which possesses the property of dissolving epithelial structures.

Boils.

Furunculus, or boil, is a circumscribed inflammation of the skin and subcutaneous areolar tissue, attended by a local effusion of lymph, and followed by the death of the central portion of the involved tissue; and this, the core, is subsequently expelled through an opening in the cutis, together with the degenerated products of the inflammatory process.

Among minor differences, which are chiefly those of degree, one may distinguish pretty clearly between such boils as are lumpy, definite in extent, and prominent on the surface, and such as are flat and less defined in their outline.

(*a*) *The ordinary boil.*—The former of these varieties generally commences as a lump beneath the skin; at first perhaps but little sensitive; this as it increases in size seems to irritate the surrounding tissues, producing pain and heat about the parts; at the same time, the external swelling becomes more pointedly conical, and acquires a bright-red blush on the surface. The pain is now more considerable, and is of a piercing, throbbing character, occasionally varied by a distressing sensation of tension and weight at the part affected, the surface of which is now exquisitely sensitive to the slightest external irritation. It is probable, as has been suggested, that the sloughing process is during this time extending through the dense structure of the

[1] A case is related by Mr. Hutchinson in the *Pathological Transactions* for 1857, of a horn growing from the angle of the mouth; the base of this eventually became the seat of a papillary epithelial cancer.

true skin; since before long a purulent spot appears at the apex of the swelling, and coincidently the local suffering is considerably diminished. This pustule, or vesicle, after a slight increase in size, bursts, and gives exit to a little sanious pus, and discloses a narrow opening leading straight through the cutis, to a greenish-yellow slough beneath. After a variable interval, the slough becomes loosened, and presents itself at the cutaneous orifice, which appears far too small for its convenient exit; through this, however, it makes its way—a small shreddy wad of dead tissue, soaked in inflammatory products. The subsequent progress towards recovery is rapid; the flask-shaped bed of the boil for a day or two discharges some sanious shreddy pus; then quickly fills up with granulations, and cicatrisation takes place, leaving behind a small, depressed, and slightly-discoloured spot.

Boils are considered by some to be confined to the true skin, and not to affect the subcutaneous tissue; the core, or slough, is also said to be almost entirely composed of inflammatory products.[1] In this opinion we cannot coincide. The slough, or core, if examined microscopically, will be found to consist of the elastic and fibrous elements of the deeper layers of the true skin, matted together by lymph in various stages of disintegration.

(*b*) *The flat, more diffuse*, or, as it is termed, the 'blind' boil, generally commences in a small inflamed pimple, surrounded by a red and exquisitely tender areola, ill-defined in its margins. The pain of such a boil is from the first of a throbbing nature, keeping time with the pulsation of the heart, and is greatly increased in severity by any excitement of the circulation, such, for instance, as follows the administration of any diffusible stimulant.

The pimple in the centre of this form of boil either very slowly pustulates, or, more generally, forms a vesicle containing blood-stained serum; and on the giving way of the cuticle, this is discharged with a little shreddy sanious pus, and with far less solid slough than separates from a common boil. The blind boil, also, so far as our own observation extends, seems to belong to a more atonic and debilitated state of system than the ordinary lumpy boil. Occasionally boils spontaneously disappear without proceeding to suppuration; such are generally slow in their formation, and cause but little pain.

For the most part, the progress of a boil is not attended by any constitutional fever, nor is their eruption preceded by any distinctive premonitory symptom; yet not infrequently individuals who have had much experience of boils in their own persons can anticipate the appearance of each fresh visitor by the occurrence of a certain feeling of general discomfort and chilliness, while in others the eruption is preceded by a transient irritability and querulousness of temper.

Boils may be stated to be in almost every case local manifestations of certain constitutional conditions. It is usual in treating of analogous affections, first to treat of the general causes and symptoms which produce and precede the local malady. But since no distinctive group of general symptoms can be pointed out as indicative of an approaching eruption of boils, we have ventured to reverse the order commonly observed in the systematic description of disease, and shall proceed from the description of the characteristic and constant symptoms of the local malady to the consideration of the less definitely marked conditions of the constitution at large, which precede and apparently occasion the eruption. We adopt this course, hoping thereby to arrive at some rational indications of treatment, not so much for the boil itself, as for the conditions of the system that determine its appearance.

Among the causes of boils, it is generally recognised that certain atmospheric conditions largely influence the predisposition of the population at large to this disorder. Thus, as a matter of certainty, we know them to be more prevalent during the spring and early summer than in the autumn and winter. Again, during certain years boils have prevailed in this country epidemically; they did so in the years 1851, 1857, and 1858, when their appearance could not be connected with any unusual atmospheric condition of which we have any cognisance. There are, however,

[1] A clinical lecture by Mr. Syme, *Lancet*, March 8, 1856, p. 269. Rokitansky makes the same statement, *Path. Anatomy*, vol. iii. p. 85.

certain conditions of the system which exercise a definite influence in the production of boils; such a condition is induced in the majority of patients under the hydropathic treatment, as it is called. Here an alteration in the patient's diet (for the most part in the direction of greater simplicity), the diminution or deprivation of stimulants, copious draughts of water, a greatly increased secretion from the skin and kidneys, will sooner or later almost unfailingly produce a general eruption of boils.

Again, a constitutional condition highly predisposing to boils is induced in those who subject themselves to the training process which prizefighters and athletes undergo, and which is necessary for those who row in races. The general experience of persons in the better classes of society seems to be, that the more out of condition they are when the training process is commenced, and the harder they train (as the expression is), the more liable are they to boils; *i.e.* the more sudden and the greater the change in their diet and general regimen, the more liable are they to boils.

Here, again, the condition of the blood predisposing to boils is induced by an alteration of the diet both in quantity and quality, by the unusual muscular exercise producing an increase in the urinary and cutaneous secretions, and a rapid metamorphosis of tissue.

The long-continued slow absorption of certain animal poisons by inhalation will in very many people, not thoroughly acclimatised to the atmosphere of dissecting-rooms and pathological theatres, produce what we term the furuncular diathesis. For confirmation of the above statement we would refer, without fear of contradiction, to those whose duties compel them to a daily and prolonged attendance in the atmosphere of a dissecting-room; and to such as doubt the relation of cause and effect in this case, we would say, under a strong and painful personal conviction of the truth of the above statement, 'experto crede.'

The contact of certain cadaveric emanations and animal secretions is, so far as we are aware, the only local cause which is of itself sufficient to cause boils; such boils, or at least the first of the crop, being situated on the part to which the poison has been applied. It is not uncommon in making a post-mortem examination where the wrists and hands come freely in contact with the fluids of the corpse to feel a peculiarly stinging sensation on the surface; and in a period varying from a few hours to a few days afterwards, one or more boils may in such a case (or where no such sensation has been experienced) appear on the surface of the hand or forearm. These boils generally commence in one of the hair-follicles on the hand or forearm, these being the spots where the poison finds most ready access to the surface of the cutis.

A statement has been made by Mr. Gamgee concerning the influence of certain animal poisons taken in the shape of food in the production of boils.[1] He states that 'the flesh of animals affected with pleuro-pneumonia, when eaten by man, causes boils and carbuncles to an incredible extent.' 'My observations,' says Mr. Gamgee, 'were made in three establishments; one where 1,500 persons were known to be supplied with diseased meat; another where several hundred soldiers were in the same position; and a third where seventy persons fed too often on the flesh of diseased animals.' It would be interesting to know the exact data upon which Mr. Gamgee founds this statement.

It is a matter of experience familiar to many, that mere changes of diet, and especially the more liberal supply of animal food to those accustomed hitherto to a scanty supply, will not infrequently bring about an eruption of boils. We see this exemplified in the case of young persons leaving their homes in the country and coming to the metropolis or elsewhere as domestic servants; such persons, 'servants in their first place,' as they are conventionally termed, are peculiarly liable to boils until they become used to the more liberal scale of diet.

There is a curious but unexplained relation existing between the diabetic diathesis, and that which precedes or accompanies the eruption of boils: on the one hand, these latter are notoriously frequent in persons suffering from diabetes; and, on the other,

[1] 'The Diseases of Animals in relation to Public Health,' *Edinburgh Veterinary Review*, 1863, p. 258.

Prout, Wagner, and others have related cases of transient diabetes occurring during the outbreak of boils.[1] We have examined the urine in several cases, but have failed to confirm these observations. In addition to the probable causes of boils enumerated above, there are many and various circumstances producing a condition of general constitutional debility, during which the patient may be attacked by boils; such as prolonged lactation, measles, scarlatina, and the continued fevers. But the conditions to which we have alluded more at length, furnish examples where the cause and effect bear more evident and constant relation to one another.

From the above considerations it would seem that the appearance of boils cannot always be connected with that condition of the system which passes under the sufficiently indefinite term 'debility;' nor can these eruptions be usually ascribed to mere alterations of quantity in the blood—to conditions of anæmia and plethora; but it seems probable they are more often due to some change in the quality of the circulating fluid.

In the instances cited, we have either the definite introduction of some poison into the system, through the lungs in those employed in dissecting-rooms, through the alimentary canal in those consuming diseased meat; or its application to the external surface of the body, as in the case of the boils of pathologists. Or we may suspect the presence of some abnormal constituent of the blood, as in the boils accompanying diabetes and pyæmia. In other cases we have cited, there is such a change of diet and general regimen as to favour the supposition that the quality of the blood has been altered by a change in the proportionate quantities of its normal constituents.

In persons predisposed to the formation of boils from constitutional causes, the exact seat of the malady is in many cases determined by some local irritation producing transient congestion of some spot on the external surface. Thus those who, by training for rowing, have acquired a predisposition to the disease, will generally suffer on the parts most exposed to local irritation—this part, from the nature of the exercise, being generally the buttock.[2] In others, the friction of the braces as they pass over the shoulders will localise a boil. Again, the forehead, just where fretted by the rim of the hat, is a favourite spot for their occurrence; and the nape of the neck, where chafed by the shirt-collar, is another. Again, we have seen boils on the back of the first knuckle of the thumb in those employed in cutting out cloth, from the pressure and friction of the scissor-handles.

Among other sources of local irritation, the application of a blister is occasionally followed by a crop of boils on the part; a poultice in some has the same effect, especially if kept long applied; croton-oil liniments in others will localise the disease; and the application of a piece of soap-plaster, as mentioned by Sir T. Watson, has been known to be followed by a succession of boils.

In many cases, however, no local cause can be assigned, and these pests may invade capriciously almost any part of the body; in our own experience we have known two instances of boil on the penis—one on the dorsum, and one on the under surface. Mr. Coulson has met with one on the dorsum of the foot; and they are not infrequent on the backs of the hands and fingers, while the palms of the hands and soles of the feet happily seem altogether exempt from the disease, and the hairy scalp is not often affected, though it is by no means exempt.[3]

The structure of the integument of the part affected exercises a considerable influence over the character and progress of a boil. In the axillæ, the perinæum, and parts where the subcutaneous tissue is loose, boils are, for the most part, lumpy, elevated, and clearly circumscribed in their boundary, and the core is earlier and more easily discharged than from those situated over the thick leathery integument of the nape, and the dense skin on the outsides of the forearms and thighs. In these parts

[1] M. Vulpian has recorded a case of temporary diabetes during the progress of a carbuncle. *Gazette hebdomadaire*, 1860, No. 49.

[2] In rowing the palms of the hands are more exposed to irritation than the buttock; but they are parts of the body exceptionally exempt from this disease.

[3] I have once seen boils on the palm of the hand.—R. J. G

the swelling is less prominent, more diffuse, and the slough slowly and more painfully separates from its subcutaneous connections.

In infants and young children boils are infrequent; and if they occur, their ordinary progress is somewhat modified, especially if the child be fat; the death of the cellular tissue is more extensive, and the loss of skin by sloughing greater; the disease in its course and termination more resembles the phlegmon of young children.

The local mischief occasioned by boils is, for the most part, transient, though the cicatrix is often permanent, since the skin, at the central point of the swelling, is not merely perforated by the escape of the core, but suffers loss by sloughing.

Twice only has it fallen to our lot to witness any serious or permanent local injury. In one of these cases, a stricture resulted from a boil situated on the under surface of the penis; in the other, the sloughing during the progress of a boil laid open the sheaths of the flexor tendons of the hand, just above the annular ligament of the wrist. This accident led eventually to destructive suppuration of the wrist-joint.

The effect of boils on the constitution at large cannot but vary with the state of the general health at the time of attack. From the consideration of some of the known causes of boils, one may venture to conclude that their action is in certain states of the blood eliminative, though their frequent occurrence, from the amount of suppuration and discharge accompanying them, and the pain they occasion, may induce or increase a condition of general debility. A more serious, but happily an infrequent, effect of boils is the purulent infection of the blood and the production of pyæmia.

Of this the following will serve as an instance.[1] A gentleman aged 46 who had suffered many times before from boils, was attacked with one on the back of his hand, which, contrary to his usual custom, he allowed a surgeon to open by incision. In a few days he was well enough to go out of doors; but the day following he was attacked by pain in the chest and dyspnœa; this was followed a day or two later by intense pain in the left hip-joint, severe constitutional fever, pain and swelling of both wrist-joints, increase of the dyspnœa, and death three weeks after the opening of the boil. The post-mortem examination disclosed an abscess in the left hip-joint, turbid fluid in both wrist-joints, and numerous pyæmic abscesses scattered throughout the lungs.

Treatment.—In considering the constitutional treatment generally adopted for boils, we shall for convenience separate the rational remedies, as they may be called, from the empirical.

When the cause of the attack is assignable with some degree of certainty, there is a definite indication of the line of treatment most likely to prove successful. Thus, boils resulting from the slow absorption of poisons emanating from decomposing bodies in dissecting-rooms or elsewhere, are best treated by the early administration of a laxative, by procuring a free excretion from the skin by means of the Turkish bath, warm baths, hot-air or vapour baths, or, better still, by muscular exercise in the open air; and by a liberal and mixed supply of nutritious food with stimulants in moderation.[2] In such a case, if a tonic seems desirable, quinine, with mineral acid or some preparation of bark, will be found most suitable.

The indications for treatment are also definite where boils are occasioned by a sudden change either in the quantity or quality of the food; and in such instances the remedies naturally suggested by the circumstances of the case are for the most part successful. In such it may generally be observed that the diet has consisted chiefly of some one class of food, to the exclusion, either partial or complete, of some other; or that the crop of boils has been preceded by some system of diet and regimen which enforces either a complete abstinence from, or a very restricted use of, alcoholic stimulants. We are here referring particularly to the scale of diet adopted by persons under training, or the hydropathic system.

[1] I am indebted to Mr. Edward Newton for the particulars of this case.

[2] During the progress of a boil, and before it has burst, stimulants, if given in large quantities, may much increase the pain.

If, in contradistinction to these systems, we observe the effects of a well-selected and sufficiently-varied scale of diet on a number of individuals of various ages and both sexes, the contrast is striking. Mr. Gover, resident medical officer at the Millbank Prison, informs us that he imagines there is scarcely any establishment of equal size in which boils are so infrequent as at that prison. Out of a population of 1,000, they scarcely have a dozen cases in a year. 'I presume,' says Mr. Gover, 'that this is due to the compulsory regularity in the habits of the prisoners, the attention paid to cleanliness, and to the fact that the diet, while not in excess, contains every element in due proportion.'

The condition of the urine often furnishes a satisfactory guide to the plan of treatment most suitable to the case—we mean an alkaline reaction, or one of abnormal acidity. The saccharine condition of urine, which has been found associated with boils by some observers, suggests a dietary theoretically appropriate; in practice, however, its adoption has not been followed by any marked success.

The effects of prolonged lactation, the convalescence from fevers or other exhausting diseases,—all of these conditions present sufficiently appreciable deviations from the standard of health to afford a guide to the treatment of boils resulting from them.

But there still remains a large number of cases in which either no definite cause can be assigned for the attack, or in which, though the cause be recognised, the rational plan of treatment has not proved successful. To such cases the various *empiric remedies* are applicable; and first among these remedies we would rank *yeast*, both on account of our complete ignorance of its action on the animal economy, and from the beneficial and speedy effect it apparently exercises in a certain limited number of cases. It may be taken fasting, a tablespoonful at a time, three times a day; and its use need not be continued longer than a fortnight or three weeks; since its effects, if beneficial, are soon evident.

Quinine, given in the manner recommended by Dr. Jackson of the United States,[1] may be recommended as an empirical though successful remedy. Dr. Jackson's plan is the following: he gives from 'twelve to sixteen grains of the sulphate of quinine, divided into three or four doses, on the first day; and if the peculiar effects of the medicine on the head and ears do not take place, he increases the quantity next day by four grains; and continues to increase the quantity daily by four grains, until there is some evidence that the patient has got as much as he can comfortably bear. On the day after some inconvenience is occasioned by the medicine, the daily quantity is diminished by four grains. If this is borne well, or whatever daily allowance is borne with ease, it is continued for four or five days, and then gradually reduced to two grains in a day.' Dr. Jackson recommends that the quinine should not be entirely given up for three or four weeks, and insists on the necessity of beginning with large doses, so as to make a distinct impression on the system as early as possible.

Acids or alkalis are occasionally administered empirically: that is, when there is no particular indication of their being required; they are in such cases given in large doses and are generally combined with some tonic. [Sulphide of calcium, in doses of gr. $\frac{1}{6}$ frequently repeated, is strongly recommended by Dr. Sydney Ringer in the treatment of boils.—R. J. G.]

Local treatment.—The list of local applications for boils, starting from the time-honoured prescription of the prophet, which is still popular among the poor, includes substances many in number, and very various in their nature and consistence; and, first, of the reputed curative measures—

Boils may be subjected to treatment of an abortive kind, and occasionally so with some success. Whatever remedy be applied with this object in view, the period when it is likely to prove successful is only in the very early stage of the boil's existence, and, so far as our personal experience extends, chiefly in the case of blind boils.

This variety may often be quenched early by the application of nitrate of silver, in the solid stick, to the part of the swelling where the vesicle is about to form: a

[1] *Letters to a Young Physician*, Boston, 1855.

drop or two of the strong liquor ammoniæ or liquor potassæ applied to the same part is said to have the same effect; and strong tincture of iodine is recommended for the same purpose. *Incisions* are highly extolled for the abortive treatment of boils by Dr. Jackson, whose work we have quoted above; he recommends the boil, when it is but two or three days old, and but a 'pimple,' to be split with a knife. Mr. Hunter,[1] Mr. Syme,[2] and many others recommend incisions as limiting the extent of the disease, diminishing the pain, and hastening the cure. All agree in advising that the incision, to be efficacious, should be complete, and employed early. We cannot but think that the employment of incisions for boils is of questionable advantage, as a general plan of treatment; it is seldom that the case is submitted to medical inspection until all hope of an abortive incision is at an end; and we question very much if the advantages claimed by Mr. Syme for his method of local treatment would willingly be purchased by most patients at the cost of the short, though sharp, pang suffered during the division of the boil: there are, however, exceptional cases of severe local pain where an incision may be practised with great relief to the patient's suffering. *Poultices* are applications which give some relief from the pain, and quicken the process of suppuration; at the same time they tend to increase the extent of the boil, and favour the formation of fresh ones in the neighbourhood; if used at all, they should be small. Water-dressing is a better application of the same kind, as being more easily localised.

An application which has great repute as a domestic remedy for boils is the bark of the slippery elm; a piece of this soaked in water forms a soft mucilaginous pulp, which, applied to the part, has much the same effect as a poultice. *Boils*, unless exceptionally painful, or occurring on very incommodious parts of the body—where their rapid suppuration and speedy recovery is all-important—are best simply protected from external injury by some unirritating form of plaster spread upon leather; soap or lead plaster spread upon kid or chamois leather is an excellent application until the boil has burst, when perhaps the emplastrum or ceratum resinæ are more suitable from their stimulant properties.

Carbuncle.

Anthrax or carbuncle is a specific form of local inflammation attacking the subcutaneous tissue and involving the skin; it is attended by effusion of unorganisable lymph, followed by sloughing of the central and deeper parts, and subsequently by destruction of the skin and the separation of the dead tissues in the form of a slough.[3]

It may be distinguished from a boil by being less clearly defined in its margins, less conical at the centre, for its size less prominent on the surface, and by its manner of perforating the skin by several apertures. At the same time it extends more deeply than a boil, the redness of the skin is of a more livid hue, the pain is more severe, and is accompanied by more constitutional disturbance. Again, unlike boil, it generally occurs singly, and for the most part affects certain localities; it belongs especially to certain periods of life, and its slough differs in its colour, consistence, and attachment to surrounding parts from that of a boil.

Carbuncle shows a decided preference for the male sex: out of 2,818 deaths from carbuncle during fourteen years—namely, from 1847 to 1860 inclusive—taken from the Registrar-General's Reports, but 784 were females.

The disease has notoriously been more prevalent in some years than in others. The deaths registered from this cause gradually increased in number from the year

[1] Hunter, *On the Blood.*

[2] A clinical lecture by Mr. Syme, *Lancet*, March 8, 1856, p. 269.

[3] For a summary of the various opinions concerning the pathology of carbuncle, see a paper by Mr. Ledwich, *Dub. Quar. Journ.* November 1856; also *Dub. Quar. Journ.* February 1864. Mr. Syme, *Lancet*, 1856, vol. i. p. 269, states decidedly that the disease 'is not subcutaneous, but seated in the skin itself.' Having carefully read his description of carbuncle, we must conclude that it differs in some points from the actual phenomena of the disease as it occurs in London.

1847, when they were 77, to 1854, when they reached 300. Since the latter date they have fluctuated between 266 and 193 per annum. In the year 1868 they were 228.[1]

These fluctuations in the yearly death-rate have occurred unconnected, so far as we can discover, with any unusual or peculiar atmospheric condition. The deaths have occurred from this disease chiefly among the middle-aged and those more advanced in life, being most frequent between the ages of 45 and 55.[2]

The common form of carbuncle is rarely met with under the age of twenty; while that variety to which we shall presently allude under the name of malignant or facial carbuncle, generally occurs in persons under thirty years of age. The disease attacks all ranks of life; the upper classes being quite as liable to it, if not more so, than the ill-fed and over-worked poor.

The causes of carbuncle may be generally stated to be purely of constitutional origin, and to depend, when any cause can be assigned, upon conditions of general debility or plethora; while not rarely, individuals are met with, who, without showing any perceptible deviation from the standard of health, exhibit what may be called the carbuncular diathesis—an unfortunate predisposition to disease. Many causes have been assigned as tending to produce carbuncle, while some have considered it of purely local origin.[3] It is, however, quite impossible with certainty to assign any particular combinations of anti-hygienic conditions as the predisponents of carbuncle.[4]

Still, from the frequent association of this disease with the gouty diathesis, one is warranted in entertaining an opinion that there is more than an accidental connection between the two, and we believe that in the same way that gout is popularly, but not altogether falsely, divided into the 'rich man's' and the 'poor man's' gout, so might carbuncle be often traced to the effects of opposite hygienic conditions acting on the gouty diathesis.

By some the prevalence of carbuncle during the last few years has been attributed to the more extended use, as an article of food, of the flesh of animals affected with pleuro-pneumonia and splenic apoplexy, diseases which during the same time have been increasing in frequency among stall-fed cattle. On this point Professor Gamgee makes a statement to the effect that he has traced the prevalence of boils and carbuncles to the use of diseased meat in certain establishments where this kind of flesh is largely consumed as food.[5] Recorded facts, however, are wanting to establish the accuracy of this statement.

Dr. Livingstone, on the same subject, writes: 'When the flesh of animals that have died of pleuro-pneumonia is eaten, it causes a malignant carbuncle; and when this appears over any important organ, it proves rapidly fatal. It is more especially dangerous over the pit of the stomach. The effects of the poison have been experienced by missionaries who have partaken of food not visibly affected by this disease.

'Many of the natives who persisted in devouring the flesh of animals which had died of this distemper, died in consequence. The virus is destroyed neither by boiling nor roasting.'

On the other hand, cases are recorded where the flesh of animals that, by external

[1] In the Registrar's tables the numbers stand thus:—

Year	Males	Females	Total	Year	Males	Females	Total
1847	50	27	77	1854	218	82	300
1848	58	33	91	1855	177	78	255
1849	64	17	81	1856	192	61	253
1850	102	32	134	1857	175	77	252
1851	112	49	161	1858	181	65	246
1852	167	66	233	1859	169	67	236
1853	190	62	252	1860	179	68	247

[2] Address by Mr. A. Pritchard, *Brit. Med. Journ.* August 8, 1863.

[3] Address on Surgery by Mr. Pritchard.

[4] See Report on Carbuncle, *Med. Times and Gaz.* 1854, p. 567.

[5] The passage is quoted at length in the section on 'Boils.' See also some remarks by the same gentleman, *Lancet*, 1864, vol. i. p. 187.

contact, produce malignant pustule in one individual, was eaten as food by others with impunity.[1] The same author relates an instance of two butchers who were attacked with charbon after having killed and dressed the carcass of a diseased ox, which, as an article of food, proved both wholesome and savoury.[2] Again, the flesh of sheep affected with carbuncular disease is eaten largely in Scotland, and that with impunity.[3]

The question of the wholesomeness, or the contrary, of the flesh of diseased animals as an article of food, and its capability to cause carbuncle, is at present *sub judice*; and until those who attribute carbuncular disease to this cause can adduce *facts* in proof of their assertions, we may fairly state that their case stands 'not proven.'[4]

Seat of carbuncle.—The disease is most usually situated on the back of the trunk or neck, occasionally encroaching on the hairy scalp, on the buttocks, or the extensor surface of the limbs, on the upper or lower lip; its favourite seat being in the dense and fibrous integuments over the posterior median longitudinal line of the body. Carbuncles have been observed on the front of the abdomen and on the sides of the thorax. As a rule, they appear but one at a time, though they may follow one another in succession.

Through the kindness of Mr. Wood of Shrewsbury, we are enabled to quote an exceptional case where the patient at one time suffered from eight; this gentleman had, on a previous occasion, been attacked by carbuncles. He was a free liver, and a large, very large eater, and he eventually died almost covered with carbuncles, having at the same time four on the back, one on the nates, two or three upon the abdomen, and one on the thigh; they were many of them very large.

A carbuncle, as it generally occurs, begins in a painful inflammatory swelling of the integuments, hard to the touch, red in colour, very obtusely conical in shape, and ill-defined in its boundaries; it gradually increases in extent and hardness, diffusing itself through the surrounding cellular tissue as a kind of inflammatory œdema. After a few days the colour becomes darker, the more prominent parts being of a livid red, where the cuticle is generally raised from the cutis by some sanious serum; on the bursting of this vesicle the cutis is seen to be perforated by several small yellow apertures, which give exit to a glutinous purulent fluid. After a time these separate holes, from the death of the intervening skin, merge into one large ragged-looking opening. At the bottom of the cavity thus exposed is seen a slimy, pultaceous slough, extending into the interstices of the surrounding cellular tissue beneath the sound skin, and possessing, as some think, a characteristic fœtor. During all this time the inflammatory œdema around may have been extending; but on the full exposure of the slough it generally begins to subside, the pain lessens in intensity, suppuration commences, and the dead parts slowly, and as it were reluctantly, separate from their connections, leaving a cavity of very irregular shape, having generally deeply undermined and jagged edges. In the progress towards cure, this is filled-in by granulations up to the level of the skin, and when cicatrised leaves an uneven and often permanently discoloured scar.

The ordinary progress of carbuncle, as above described, may occupy an uncertain interval of time extending from a fortnight to some months; indeed, in a few instances, the vitality of the skin for a long while resists the sloughing progress which takes place in the tissues beneath, giving rise to a chronic carbuncle, where the slough is both slow to form, and when formed is for a time imprisoned by the integuments; such carbuncles, if opened, have the appearance of an abscess with semi-solid contents.

The slough consists of the subcutaneous cellular and fibrous tissues, abundant oil-globules, and the products of the inflammatory process in various stages of disintegration. The depth to which it penetrates is uncertain; but not infrequently on the separation of the dead parts the muscles below are seen completely bared, or even to

[1] Bourgeois, *Pustule maligne*, p. 73.
[2] *Ibid.* p. 165.
[3] *Med. Times and Gaz.* 1863, p. 564; also 1864, vol. i. p. 217.
[4] We do not of course allude to parasitic diseases.

some extent involved in the sloughing. To such a depth may the disease extend that a carbuncle on the anterior abdominal wall may produce fatal peritonitis.[1]

Death may occur in this disease from exhaustion caused by the sloughing and discharge from the carbuncle; these, however, alone rarely produce sufficient depression of the vital powers to cause death; more frequently, if death occurs in this manner, the fatal exhaustion has been occasioned or aggravated by hæmorrhage from incision of the carbuncle.

When the disease invades to any extent the hairy scalp, death may occur in the same manner and from the same cause so frequently seen in erysipelas of the head; the fatal issue being conventionally attributed in these cases to cerebral effusion, or inflammation of the membranes of the brain.

By far the most frequent and efficient cause of death in carbuncle is pyæmia, as characterised during life by rigors, profuse sweats, and general depression, and occasionally by the formation of external abscesses, and as evidenced after death either by multiple deposits of a fibrino-purulent nature in the liver, lungs, kidneys, and spleen, or by secondary abscesses in the same organs or elsewhere.[2] During the progress of the carbuncle the urine is thought by many to be saccharine. Cases of this kind have been recorded by Prout, Wagner, and M. Vulpian. But we believe this may be merely a coincidence, as we have been unable to find glycosuria accompanying the attack of carbuncle, nor was this condition of the urine found to exist in thirty-five tabulated cases reported in the 'Medical Times and Gazette' for 1854, p. 569.

Treatment.—Since such conflicting opinions exist on the subject of the local treatment of carbuncle, and as surgeons of eminence and experience take such strong and opposite views on the question, we shall briefly allude to the most common plans of practice. At the same time we venture to suggest that some of the warmest supporters of particular and exclusive methods of treatment seem to pay but little heed to the collateral circumstances of each particular case and the general condition of the patient.

And first, there are those who advocate and practise incisions of various kinds, as exercising a direct effect in the limitation of the disease both in its duration and extent.

Secondly, those who repudiate incisions and advocate various kinds of caustics, ascribing to these a similar effect.

Thirdly, there are those who make use of local applications, of a more simple and less heroic kind; and, distrusting the efficacy of both caustics and incisions as means of limiting the extent of the disease or hastening its termination, trust to the constitutional powers of the patient, and the general tendency of local inflammatory diseases to bring about a favourable issue. More recently a plan of local treatment by pressure has been introduced; it is said to limit the extent of the disease, to relieve the pain, and to hasten the separation of the slough.

1. The treatment by incision is adopted in the progressive stages of carbuncle; that is, at any time before the slough has begun to separate, or the inflammation to subside; it is probably the most popular plan of local treatment; and it generally consists in a free crucial division of the carbuncle from the surface towards the deeper parts, extending into the living tissues around and beneath.

An internal or subcutaneous crucial incision has been recommended by Mr. French. In this method a tenotomy knife, with its edge upwards, is introduced into the circumference of the induration; and the whole mass is divided from the deeper parts towards the skin, taking care not to wound the latter, except at the point of puncture; a second subcutaneous division is then made, in the same way, at right angles to the first. When the bleeding has ceased, Mr. French recommends that the surface of the carbuncle be covered with collodion, the slough being allowed to escape through the punctures in the base of the swelling.

[1] *Brit. Med. Journal*, August 8, 1863, p. 152.

[2] For instances of death by pyæmia from carbuncle, vide *Guy's Hospital Reports*, 1861, p. 466.

Another species of subcutaneous division is employed by some; the parts being split horizontally. By others, the swelling is subcutaneously broken up, and subdivided with a long narrow knife passed in at the side.

2. The method of local treatment by caustic consists in the free application of caustic potash in substance to the centre of the tumour, until the latter is thoroughly disorganised. This plan has been highly recommended by Dr. Physic, and at his suggestion has been extensively adopted in America; while in this country, among others, Mr. Higginbottom and Mr. Pritchard have chiefly advocated the same treatment, which is thus described by the latter gentleman: 'In whatever stage the carbuncle is, the potash is to be applied, and rubbed in freely in the centre until an eschar is fully formed. In the earlier stages, if the skin is still unbroken, it must be used for several minutes, until the death of the central portion is insured; the size of the slough to be made varies with the size of the carbuncle. In general terms, the diameter of the skin to be destroyed should be a fourth, or even a third of the diameter of the indurated and inflamed mass.' This, says Mr. Pritchard, is generally sufficient to stop the progress of the disease. Subsequently, the parts are to be covered with resin, turpentine, or camphor cerate, poultices being avoided. The circumference of the swelling may be covered with collodion, or a strong solution of lunar caustic. Strict cleanliness is to be observed, and the slough allowed to separate spontaneously.

The advantages claimed for this plan of treatment are the following: the avoidance of hæmorrhage; a diminution in the extent and duration of the disease, and thereby a saving of strength to the patient; and a freedom from pyæmia.[1]

3. Coincidently with a widespread and increasing belief in the general tendency of local inflammatory diseases towards spontaneous recovery, a doubt has arisen in many minds of both the efficacy and necessity of such remedial measures as have for their object the cutting short of the progress of a carbuncle. Thus it is that many surgeons, formerly advocates for crucial incisions, are now content to allow the local malady to run its course; while, by a judicious administration of constitutional remedies, they endeavour to husband the strength of the patient, and to place him in the best position to support the tax on his vital powers. This treatment is adopted on the conviction that neither local incisions nor caustics favourably influence the duration or extent of the disease; while, by avoiding incisions, one source of danger—that of exhaustion by hæmorrhage—is altogether excluded; and this is no questionable advantage in old or enfeebled patients. At the same time, another perilous complication, that of pyæmia, is less likely to occur in this plan of treatment than in the case where incisions are employed.

The application of pressure as a curative agent to carbuncles was first advocated, we believe, by Mr. O'Ferrall, who has since embodied his views and experience on this subject in a pamphlet. Strong testimony to the efficacy of this plan of treatment has also been given by Mr. M. H. Collis, in the 'Dublin Quarterly Journal,' Feb. 1864.

The manner of applying pressure is thus described by Mr. O'Ferrall: 'The compression must be firm, and must begin at the periphery of the swelling, and gradually approach its centre. In the early period of the practice, I was accustomed to apply a circular piece of brown soap-plaster, spread on leather or cotton cloth, leaving an opening for the discharge of the pus. This succeeded in many instances; but I found that a firmer support was necessary, in order to give immediate ease to the patient. I therefore covered this piece with straps of plaster, drawn tightly from the neighbouring sound parts, and they by traction exerted a firm degree of compression on the swelling. In some localities, where the tumour is of small size, and traction of the skin is not easily accomplished, I have found a coating of collodion of considerable service, producing, by its contractile properties, a nearly similar result.'[3]

[1] *Vide* a comparison between the results of treatment by incision and by application of collodion, *Year-Book of Med. and Surg.* 1862, p. 165.

[2] *Dublin Hospital Gazette*, 1858, 'On the Treatment of Anthrax by Pressure.'

[3] *Ibid.*

In reviewing the methods of treatment, we believe that that by incision has the advantage of very generally affording complete relief from pain; that it arrests the further extension of the inflammation is less certain, and we much doubt if the final cure is by it at all expedited.

Among the various kinds of incision for carbuncle, we have not been able to discover that any method possesses an advantage over the time-honoured crucial cuts. The treatment by incision has the disadvantage of causing hæmorrhage, and, it may be, of exposing the patient's life to increased risk from pyæmia; if employed after a carbuncle has ceased to make progress, this treatment may do damage by interfering with the natural process of cure, and by increasing the area of sloughing and suppuration.[1] No universal plan of incising carbuncles, as recommended by Mr. Syme, can be adopted without great danger to many sufferers from the disease. To the young and vigorous, the employment of the knife may bring relief from pain without risk to the general strength; while in the case of those who are debilitated by age or other causes, the questionable local advantages of incision are far outweighed by the certain risk incurred by the constitution at large.

As a local application after the division of a carbuncle, a poultice may be used, or, what is better in many cases, lint steeped in turpentine, spread over the surface; or if there is any tendency to continued hæmorrhage, the lint may be stuffed into the cuts with a probe.

Of the employment of caustics we have no personal experience; it is a plan strongly recommended by competent observers and surgeons of high repute, who have had large opportunities for forming a sound and discriminating judgment on the subject. Of local applications to carbuncle (until the slough begins to separate), the most comfortable to the patient is the common linseed-poultice, or wet lint and oiled silk; the poultice is of itself too relaxing to many skins, and liable to give rise to boils in the neighbourhood; it is rendered more suitable to the particular malady by being smeared over with turpentine and resin cerate. Frequent syringing with warm water, a weak solution of chloride of zinc or of carbolic acid, will quicken the process of separation when the slough has fully formed; and occasionally from large carbuncles considerable masses of slough may be advantageously cut away with scissors.

To the granulating surface after the separation of the slough some application of a stimulant kind is best suited, such as the Peruvian balsam or the cerate of turpentine and resin; while the edges of the cavity may usefully be approximated by careful strapping with plaster.

The constitutional treatment and general management of patients suffering from carbuncle is best conducted on general principles, and on such indications as the age, circumstances, manner of life, and standard of health of the patient afford, and not upon any specific or universal line of treatment directed to the particular disease.

The bowels, if they require attention, may be acted on by some non-irritating aperient; and the diet, if it be necessary to give much nourishment, should be given in an easily assimilable form. It occasionally happens that, starting from the carbuncle, an erysipelatous inflammation of the skin spreads to the parts around; this it is advisable to treat either by the application to the surface of strong collodion, or a paint recommended by Mr. Pritchard of Bristol, consisting of iodide of potassium and iodine, each a scruple to one ounce of collodion;[2] or the strong caustic solution recommended by Mr. Higginbottom may be advantageously applied.

Facial carbuncle.—Under this name we propose to describe a disease of carbuncular character, which often differs in its progress and consequences so much from the ordinary affection as to require a separate notice. Having most external characteristics in common with carbuncle, in its constitutional effects this disease may be said to bear much the same relation to the latter as does scarlatina maligna to scarlatina simplex. Whether the fatal tendency of facial carbuncle depends upon the structural

[1] Vide *Med. Times and Gaz.* 1854, p. 571, report on Carbuncle.
[2] *Brit. Med. Journ.* 1863, p. 155.

peculiarities [1] of the part affected or upon the essential nature of the disease, we shall not venture an opinion.

Facial carbuncle has been described, under the name of multiple furuncle of the face, by M Dumereuil.[2] It has been alluded to as agminated furuncle of the face by Bourgeois, in his work on malignant pustule. In this country, as we believe, the disease was first described by Mr. Harvey Ludlow, in a paper entitled 'Carbuncular Inflammation of the Lips and other parts of the Face';[3] and this is one of the best accounts of the disease that is published.[4] The cases published by Mr. Ludlow have been claimed by a recent writer on malignant pustule as instances of the latter affection.[5] 'The cases reported by Mr. Ludlow,' says Dr. Budd, 'are all characteristic examples of malignant pustule.' From this assertion we venture entirely to dissent. In speaking of cases of facial carbuncle, M. Bourgeois, in his work on malignant pustule, states that it is not uncommon to meet with a fatal termination when carbuncle occurs about the mouth or other parts of the face; and that this disease is to be distinguished from malignant pustule by its painfulness, the presence of pus, the character of the swelling, and by other characteristics to which we shall presently allude.

In support of the opinion expressed above, we would direct attention to the following particulars: M. Bourgeois [6] remarks of malignant pustule that its name is singularly inappropriate, since it conveys an idea of some purulent formation; whereas the secretion of pus is so opposed to the essence of the disease that the recognition of the smallest quantity, in a doubtful case, would show the disease at once to be of some other nature than malignant pustule. At page 301 of the same work, among other diagnostic signs of malignant pustule, the complete absence of pus is enumerated, 'since, if it appear spontaneously, or follow upon pressure, one can say certainly that the disease is not of the nature of charbon.'

On examining the six cases reported by Mr. Ludlow, we find that in five it is stated that pustules appeared on the surface of the part affected; while in the other case, when the diseased parts were incised during life, a thick pultaceous matter is said to have issued from the cut surface, which exhibited punctiform deposits of pus. Out of the five cases that presented external evidences of pus, four were cut into during life; and of these it is distinctly stated that there were isolated infiltrations of pus seen on the cut surface. In all these cases, therefore, pus was found to exist.

Of pain as a symptom of malignant pustule, M. Bourgeois remarks that one important diagnostic sign of the disease is the almost complete absence of pain: and elsewhere he remarks, a singular circumstance is the little pain these enormous swellings produce: while of Mr. Ludlow's cases it is related that one 'suffered intolerable pain,' another 'suffered acutely,' a third had 'sharp throbbing pain,' in another case the pain was 'very severe,' and in two cases the disease is said to have been 'very painful.'

These cases, therefore, differ from malignant pustule by possessing those very symptoms that are stated by Bourgeois to be characteristic of carbuncle of the face. In addition to this, at the time the cases occurred, the question of their being instances of malignant pustule was considered and negatived both by Mr. Ludlow and by others well qualified to form a sound and discriminating judgment.

That carbuncles form on the face, and running the ordinary course of that malady,

[1] The facial vein differs from other external veins in being less flaccid in its walls and more patent in its canal, and communicating at its lower dependent end with the jugular, and by its upper with the sinuses of the brain; thus affording unusual facilities for the escape of morbid material from its canal into the general circulation.

[2] *Gazette hebdomadaire*, 1863, No. 47.

[3] *Med. Times and Gaz.* September 1852.

[4] See also *Archiv. gén. de Méd.* 1870, Juin. 'Recherches sur les causes de la gravité particulière des anthrax et des furoncles de la face,' par J. D. Reverdin.

[5] *On the Occurrence of the Malignant Pustule in England*, by W. Budd, M.D. London, 1863.

[6] *Pustule maligne et Œdème malin*, par J. Bourgeois, Paris, 1861.

produce no unusual constitutional disturbance, is a matter of common observation; but that carbuncles, differing in their early stages in no recognisable feature from the above, not infrequently prove fatal, is but too true.

Facial carbuncle generally commences in a small itchy pustule or vesicle upon one of the lips (the upper lip for the most part); this vesicle, in a day or two after its rupture, is followed by a firm œdematous swelling of the lip, also of the nose and cheek, producing a hideous deformity. A few pustules, or vesicles, generally soon show themselves about the red edge of the lip, and the swelling extends; the surrounding induration being perhaps less defined than in carbuncle occurring elsewhere. The pain is most intense, and the colour of the surface generally passes through the shades of bright red, dusky red, and dark plum colour, until it is almost black, particularly about the mucous margins of the lips. Suppuration is slow to occur; but, if the patient live long enough, pus will form and be discharged together with the disintegrated cellular tissue.

The constitutional symptoms early in the disease indicate great depression of the vital powers, the pulse being generally frequent and feeble, the skin hot, and the tongue soon becoming dry. Too often rapid breathing with pneumonia or pleurisy supervenes, and death occurs from pyæmia; the purulent infection of the blood either originating in facial phlebitis, as evidenced by the swelling and induration in the course of the veins, and spreading upwards through the orbit to the cavernous sinus, where pus may be formed; or it may be the general circulation is contaminated through the facial and external jugular veins.[1]

The following furnishes a characteristic example of the disease; we are indebted to the kindness of Sir James Paget for its particulars. A young gentleman of moderately strong constitution, when in his usual health, noticed a small pimple on his upper lip; it gave him no pain at first, but on the second day it enlarged, and became painful; on the third day he kept his bed, with increasing pain and swelling, and some constitutional fever. He quickly became worse; and on the fifth day the whole of the left half of the upper lip and part of the adjoining cheek were occupied by a thick hard carbuncular swelling not very distinctly defined in extent. The skin over it was dusky brownish and purplish red, and the rest of the cheek was œdematous, dusky, and hot. He had severe burning pain in the part; the pulse was 145, full, jarring, and rather hard; the tongue was dry and brown down the centre; skin hot and dry; thirst extreme; slight headache; he had had no shivering or sickness, and his appetite was good. The carbuncle was split from the mucous edge of the lip; there was considerable hæmorrhage, which recurred a short time afterwards so freely as to require pressure to restrain it. He was ordered plenty of wine with nourishing food and bark. After the incision, for the first day the swelling and pain much subsided, the face regained a more natural colour, and the patient passed a good night. On the seventh day, though the parts had lost some of their hardness, yet the general swelling had increased in extent, and pus began to be discharged in flakes from the wound. In his general condition the patient was not worse. On the eighth day the carbuncle had still further suppurated, the general œdema had extended over the eyelids, and there was marked protrusion of the eyeballs and chemosis of the conjunctiva. The pulse had fallen to 104, the skin and the tongue were moist, Next day, the ninth of the disease, the pulse fell to 84, the patient became torpid, and at length nearly unconscious. He ceased to care for his food, his urine passed involuntarily, he became restless, trying to get out of bed; the eyes were still further protruded. A purge was given, the quantity of stimulant diminished, and a blister applied to the nape. Next day his general condition was rather improved, though the eyeballs protruded more; a slough had separated from the lip, and pus issued sparingly from small holes in its surface; there was redness and swelling over the right temple. On the eleventh day, he partially recovered his consciousness and power of voluntary micturition, and seemed better generally. On the twelfth he was still better; a small abscess was opened over the nose; pustules appeared on the eyelids. The carbuncle was at this time discharging thick pus, was shrinking and softening; pulse 104, with good power; food and wine taken readily. Next day the improvement continued in all respects. On the fourteenth day he again became dull and heavy, his pulse rose to 148, his urine was retained, a swelling appeared on the parotid; meantime the carbuncle was healing, and the swelling of the face was diminishing. During the next two days he became worse; a pustular eruption appeared about his abdomen and thighs, and two abscesses on his forehead; and he sank on the sixteenth day; the carbuncle being nearly healed, the swelling on the face having almost disappeared, and the protrusion of the eyeballs having diminished in extent. During the last few days of his illness there had been noticed some fulness of the veins about the left eyelid, and a feeling of induration about the lower part of the facial veins.

[1] Vide *Transactions of the Clinical Society*, 1870, 'On Malignant Carbuncle of the Face,' by T. Smith.

The cause of death in this case, as in others of which we possess the histories, appears to have been pyæmia, as evidenced, in the case quoted, by the secondary abscesses which formed, and perhaps by the pustular eruption, which, occurring as it did coincidently with an aggravation in the constitutional symptoms, probably indicated a purulent infection of the blood.

From the local symptoms alone, we know of no circumstance that will enable us to determine with certainty in cases of facial carbuncle whether the disease will be of the benign form or otherwise. Early suppuration, moderate pain, and a distinctly limited area of inflammatory œdema, are favourable signs; while the opposite conditions portend, but by no means infallibly indicate, an unfavourable issue to the case. The constitutional symptoms are often the first warning of the serious nature of the disease, and they are generally from the very first of an asthenic type; yet it not infrequently happens that nothing to excite anxiety occurs either in the constitutional or local symptoms until the access of well-marked pyæmic rigors.

Treatment.—In the treatment of facial carbuncle topical remedies seem to have even less effect upon the disease than when employed elsewhere; and incisions, if they exercise (as we believe they do) but little beneficial effect when used for carbuncle in other parts of the body, exercise still less when employed on the face. The indications for general treatment are best found in the constitution and condition of the patient: nutritious food and an abundant supply of stimulants being generally required. Sir James Paget has had good success from the employment of quinine in this disease in very large doses; sufficient, that is, to produce the characteristic symptoms of cinchonism.

Malignant Pustule or Charbon.

The following description of this disease is chiefly taken from M. Bourgeois' work entitled 'La Pustule maligne et Œdème malin' (Paris, 1861). For an exhaustive list of the various Continental authorities on this subject, we would refer the reader to an excellent pamphlet on the occurrence of malignant pustule in England, by Dr. William Budd, who has collected a number of interesting cases to establish the existence, and even to some degree the prevalence, of malignant pustule in our own country.

Certain herbivorous mammalia—namely, oxen, sheep, and goats; horses, donkeys, rabbits, hares, and it may be others, are liable to an internal disease, or type of disease, to which various names have been applied. As a class, these affections are termed 'charbonneux' by the French. The particular disease, as it occurs in the ox and sheep, is termed in this country 'the blood,' 'joint-murrain,' 'black quarter,' or the 'quarter evil.' The French synonyms for the same are 'quartier,' 'charbon,' and 'sang-de-rate' in the case of sheep; while in the ox the disease is termed 'le sang,' or 'maladie de sang.' In Germany the same disease is termed 'milzbrand.'

Malignant pustule or charbon in man is derived from the poison generated by this disease in animals. The disease can be communicated to man by direct contact with the hair, the hoofs, the horns, the hide, the bones, the flesh, or the blood of the diseased animal; and in this way butchers, farriers, shepherds, and curriers usually acquire the disease: while straw or other litter, hurdles, splinters of wood, stones, articles of clothing, may act as media for the communication of the disease to man. Flies and other insects that have been in contact with the carcases of diseased animals may also transmit the disease.[1] The use of the flesh and milk of diseased animals is a more doubtful medium of infection; indeed, so many are the instances of a negative kind, where flesh that has caused malignant pustule by simple contact has been taken as food with impunity, that M. Bourgeois hesitates to include this as a means of infection.

Similarly, it is doubtful if the disease can be communicated by contact from man to man, or from man back to animals; such experiments having been at present always followed by a negative result. Nor is it probable that the disease can be

[1] Instances of nearly all the above-mentioned modes of contagion are given in M. Bourgeois' work.

communicated to man in the way of infection; we mean simply by atmospheric influences, and without actual contact with the poison.

The disease almost always attacks some exposed part of the body, and is therefore most common on the face and hands. This is as one would expect, from the local origin of the malady.

For some time after its onset, malignant pustule is a purely local affection, and during this stage it is within control; and if the proper treatment be adopted, it can almost certainly be arrested, and the constitutional effects of the malady be averted.

The following is the usual course of the disease: from one to three days after the application of the virus to the surface of the body, there appears on the part a small red spot like a flea-bite, which is sometimes preceded, and is always accompanied by a smart itching. After twelve or fifteen hours, a small vesicle appears on this spot about the size of a pin's head, containing a little brownish-red or yellow serum, on the rupture of which the itching generally ceases, and the skin beneath is seen to be dry and of a yellowish-brown or black colour. This discoloured spot indicates death of a thin layer of the true skin, which soon extends through its whole thickness.

In less than twenty-four hours a fresh crop of vesicles appears, distended with brownish-yellow serum; they are situated in an irregular circle around the eschar of the skin. At this time the eschar is depressed, dry, of a brownish-yellow or black colour, and but little painful on pressure. After twenty-four or forty-eight hours, the parts beneath swell, harden, and form a solid lump, which is pretty well defined in extent, and can be raised with the finger from the surrounding tissues ('bouton'): this swelling is occasionally absent. The mortification now extends up to, and even beneath, the circle of vesicles. As these are destroyed by the extension of the mortification, fresh ones form on the parts around; while the skin about, which at first was pale, reddens and finally becomes of a livid red colour. As the swelling increases, œdema comes on in the surrounding integument, which is ill-defined in its borders, gradually fading away into the healthy tissue. This swelling is but little painful, the temperature is but slightly raised, and it gradually extends itself, while bullæ form over the dead tissue towards the centre of the swelling. The central slough enlarges, but not to any great extent or depth; it is now extremely hard, while the surrounding swelling and œdema may become enormous. A curious fact, says M. Bourgeois, is the little pain that these large swellings cause; and that when they become painful it may be looked upon as a hopeful sign that a reactionary process has commenced. If the disease be situated upon the trunk or extremities, inflamed and indurated lymphatics are often seen stretching away from the swelling to the neighbouring glands. Such is the usual course of a malignant pustule: at first a red spot, then a vesicle, then a solid and circumscribed swelling beneath ('tumeur charbonneuse') surrounded by a diffused and softish œdema, a dry leathery central eschar, and a secondary formation of vesicles or bullæ.

The more characteristic signs as distinguishing this disease from others may be stated to be a remarkable freedom from severe pain, the little increase in the temperature of the parts, the dryness of the slough, the *entire absence of pus* in all stages of the malady, and the fact that the destruction of the tissues proceeds from the skin towards the deeper tissue, and not, as in carbuncle, by a central sloughing of the subcutaneous parts, followed by death of the skin.

Malignant pustule generally runs its course either to a favourable or fatal issue in a period varying from four to nine days. One must not suppose, says M. Bourgeois, that all malignant pustules follow this succession of changes exactly as described above. In some cases the eschar is not larger than a lentil, and occupies but a part of the thickness of the integument, the surrounding œdema hardly exceeds the 'tumeur charbonneuse' in extent; which latter may even not exist, and these differences are consistent with the most favourable or fatal issue. Still, for the most part, the more extensive the local affection, the more is there to be apprehended as regards the issue of the case.

Constitutional symptoms.—These may early show themselves; often soon after the appearance of the first vesicle, the patient being seized with rigors, headache, and

symptoms of general depression. At other times the symptoms come on a few days later, most commonly showing themselves between two and three days after the appearance of the circumscribed swelling ('bouton') at the base of the eschar; very soon the tongue becomes coated with a white fur; the pulse is full, frequent, and soft; the bowels constipated; the appetite is lost. These symptoms are generally followed by bilious vomiting, depression, faintings, difficulty of breathing, loss of sleep, a coldness of the external surface, a failure of the pulse, cold sweats, and the patient generally dies in a condition much resembling that of collapse from cholera; delirium is rare. Usually before death the local swelling ceases to increase; indeed, in some few cases, may recede, while the colour of its surface becomes more livid and it loses its temperature.

Post-mortem appearances.—The decomposition of the body is very rapid. The serous cavities generally contain a small quantity of darkish serum; the blood is found fluid and dark-coloured; small ecchymoses are often found on the mucous membrane of the stomach and small intestines; the spleen is engorged with blood and softened; the liver and other parenchymatous viscera are more or less congested with dark-coloured blood.

The posterior lobes of the lungs are much loaded with blood, and the bronchial mucus is blood-stained.

The heart and brain show the same tendency to early softening and passive congestions; the local slough, if examined, is found to consist of dry stratified layers, dark brown or black in colour, like old leather in consistence, and creaking when cut with a knife.

Prognosis.—Of the various circumstances influencing the prognosis, M. Bourgeois enumerates—1, the age; 2, the seat of the affection; 3, the constitution of the patient; and 4, the local character of the disease, and its duration before treatment is adopted. 1, the younger the patient, the better is the prospect of recovery; 2, the head and neck are the most dangerous seats of malignant pustule; 3, as in other diseases, the amount of constitutional resistance the patient can oppose to the malady largely influences his chance of recovery; 4, it is a highly favourable circumstance if the patient is seen when the disease is still local, and before the symptoms of general blood-poisoning have shown themselves; and the prospect of recovery is less bright the longer the time that has elapsed since the onset of the malady, and the greater the severity of the constitutional symptoms. A favourable local sign is the existence of a bright-red flush over the part, and any considerable increase in the normal temperature; also the distinct limitation of the local induration may be looked upon as a circumstance of favourable augury.

Treatment.—Since this malady in its first onset, and for an uncertain period afterwards, is merely a local affection, it is for a time within the control of local remedies; these being any of the more active forms of potential cautery and the hot iron. M. Bourgeois agrees with others in recommending, as the most efficient and easily-applied form of caustic, the solid hydrate of potash, which the former gentleman uses by rubbing the solid stick of potash into and around the eschar and its surrounding vesicles, until it is thoroughly destroyed and the healthy tissues are reached; the semi-fluid detritus is then to be wiped away, and the dead parts allowed to separate by ulceration.

In cases where the disease has made great progress before being subjected to treatment, and the tissues are penetrated to some depth, M. Bourgeois recommends that a layer from the surface of the eschar be raised and removed with a knife, and the potash be then applied. In any case where the local slough extends after the application of the caustic, the latter must be reapplied as soon as the non-arrest of the local disease becomes evident.

The constitutional remedies in this disease are such as the general symptoms of the case would suggest, the indication being to avoid all measures likely to exhaust the patient, and to administer stimulants and nourishing food in an easily assimilable form.

Occasionally malignant pustule assumes another external appearance, to which

M. Bourgeois gives the name of malignant œdema.[1] It differs from malignant pustule only in its external manifestation; in all more essential features the diseases are identical. It is generally met with about the eyelids and face. The prominent feature of this form of the disease is a softish, ill-defined, indolent-looking œdema of a pallid colour, rapidly increasing; the subsequent formation of vesicles is less regular, and the appearance of a characteristic central eschar may be absent, as also may be the central induration.

Since the writing of the original article, this disease has been the subject of careful investigation, and the literature of the subject is now very extensive. It is now known to depend upon the presence in the blood and other parts of the body of a large bacillus whose characters are well marked and unmistakable. A disease affecting woolsorters, and known as 'woolsorters' disease,' has been traced to the same cause. It would be out of place in this work to enter at all upon the natural history of the affection; those who are desirous of studying it are referred to the following publications:—'Recherches expérimentales sur la maladie charboneuse,' par H. Toussaint, of Toulouse; the article on Anthrax by Böllinger, in 'Ziemssen's Encyclopedia of the Practice of Medicine,' translation by D. Albert H. Buck, vol. iii.; the Brown Lectures, by Dr. W. S. Greenfield, delivered at the University of London, and published in the 'Lancet,' 1880, 1881; and to the most important researches of M. Pasteur, a brief account of which will be found in his address at the recent meeting of the International Medical Congress of 1881. At the same time little or nothing need be added to the account of the local symptoms, except to say that in some examples of the disease the buttons may be absent, while a diffuse local œdema is found. An interesting communication by Mr. Davies Colley is to be found in the Medico-Chirurgical Transactions for 1881. He points out that while the disease is very uncommon in most parts of London, a considerable number of cases are brought to Guy's Hospital which have originated in the leather warehouses of that locality. The Guy's Hospital surgeons are strong advocates of early and free excision of the affected part. It is perhaps also wise to mention glanders in connection with anthrax as a disease that might possibly be confused with it; an account of this disorder will be found in the essay on Animal Poisons.

Chilblain.

This term is applied to certain characteristic local inflammations of the integument of an asthenic type, subject to regularly recurring attacks of congestion. They appear in persons predisposed to the affection under circumstances of sudden variations in the external temperature.

A predisposition to this affection often prevails in certain families; it exists most frequently in the young of both sexes, and in adult females more often than in men. This liability to chilblains generally passes off as manhood comes on, and is but rarely met with in men over forty years of age, though in women it may continue throughout life.

The predisposition to chilblains is often connected with a certain slowness or feebleness of the general circulation, as evidenced by cold feet and hands, and occasional lividity of the finger-ends and lips during winter-time. Their appearance is generally ascribed, and often with truth, to the too sudden warming of a part when thoroughly chilled down by previous exposure to cold. But a change of weather, or of residence to a colder neighbourhood, a sudden thaw after snow or prolonged frost, or the appearance of an east wind, is sufficient to occasion them in many persons. In some individuals, if the hands or feet are chilled down, from any cause, below a certain standard, notwithstanding all precautions to the contrary, it is impossible to restore the temperature without producing one or more chilblains.

There are three kinds, or rather degrees, of chilblains: 1st, where there is simple congestion, generally attended by great itching, alternating with periods of extreme

[1] Bourgeois, p. 105.

tenderness to external pressure; 2nd, where vesication occurs; and 3rd, where death of the subjacent skin or areolar tissue takes place.

The same chilblain may pass through all these phases in the above-named order; but more frequently we find that in the same individual chilblains run a pretty constant course. In some they do not vesicate or break; in others they vesicate easily, and on breaking show superficial excoriations; in others, after breaking, the subjacent integument is found ulcerated or more completely devitalised. Again, some persons suffer from chilblains which itch but little, but show themselves as red and intensely sensitive swellings of the integuments. From the appearance of a chilblain in its early stage but little information is to be gained as to its eventual result. Most persons, however, know too well what course their own chilblains will pursue from repeated experience.

The local symptoms and appearance of chilblains are too familiar to require a special description, and we therefore pass them by to allude to a peculiarity belonging to this affection, which, we believe, has not previously attracted notice. The peculiarity to which we wish to draw attention is that regular and periodical exacerbations occur in the local symptoms so long as the chilblain is in progress.

Almost all chilblains are subject to a diurnal attack of congestion, which occurs during the afternoon or towards evening, when the affected part, by a feeling of increased heat and a pricking sensation, shows signs of an increased afflux of blood; this is soon followed by intense itching, then by swelling, with relief to the irritation; and lastly succeeds a condition of soreness, aching, and extreme sensibility to pressure, which continues throughout the night, and is peculiarly appreciable next morning, when the sufferer puts on his shoes or boots.

The exact hour of the daily attack of congestion, as well as its severity, may, within certain limits, be influenced by external circumstances. Thus the attack may be hastened by anything which stimulates either the local or general circulation of the body, such as the exposure of the parts affected to the warmth of a fire or a heated room. The constitutional effect of the midday meal in children, and the evening dinner in adults, is generally sufficient to determine the period of attack; children for the most part suffering in the afternoon, adults in the evening, during or after dinner: conversely the opposite effects may be observed where external circumstances are unfavourable to the advent of the attack, which latter may be postponed until after the sufferer has retired to rest. In many young persons at boarding-schools the extremities are cold throughout the day; and it is not until the child is in bed that the general temperature is restored to its natural standard. The severity of each daily exacerbation generally bears a direct relation to the degree of cold to which the patient has been previously exposed; and the colder the chilblains are in the morning, the more will they itch in the afternoon.

We have occasionally met with persons whose chilblains are subject to two attacks of congestion daily: the first occurring late in the afternoon; the second at night-time, when the parts are warm in bed. In some few persons chilblains do not itch at all—they tingle and burn during the daily attack, and at other times are swollen and extremely tender.

During the onset of the diurnal exacerbation the general circulation is quickened, and the temperature of the affected part is considerably raised, being often ten degrees or more above that of the part before the attack set in, and from one to six degrees above the neighbouring surface of the healthy skin.

Chilblains generally appear on those parts of the body where the circulation is most liable to be affected by changes in the external temperature. In the same individuals, however, the part of the body attacked every winter is little liable to vary. Some suffer on the hands alone; others on the feet only; while others may be attacked on both hands and feet; or, again, the lobes of the ears may be the seat of chilblain, or even the end of the nose. [I have seen chilblains extending under the nails.—R. J. G.]

Of the local causes of this affection those are most efficient that hinder the free circulation in a part, and thereby allow external cold to exercise its most depressing

effects; such are tight gloves, elastic bracelets and garters, tight shoes, sitting long in cold rooms with the feet pendent, and other circumstances of a like kind.

Treatment.—Though in some persons no precautionary measures will prevent the occurrence of chilblains, nor will any remedy remove them, yet even in these individuals both their number and their severity may be favourably influenced by appropriate treatment; while in other persons the attack may be either altogether avoided, or if it occur, the chilblains may be cured.

Of general measures either to prevent or mitigate the severity of an attack, the most efficacious are such as promote a vigorous state of the general circulation. In matters of diet, the addition of a glass or two of wine to the daily food, or a morning draught of warm milk with rum, will often prove of service; while if medicine be required, small stimulant doses of opium with quinine may be advantageously given. In persons liable to chilblains, and especially in young people, additional underclothing should be worn during cold weather; and, if possible, an even temperature should be maintained within doors by fires in the sleeping-rooms—for among time-honoured conventionalities, none, in the case of young persons, is more conducive to chilblains than the great inequality that generally exists between the temperature of the sleeping and sitting rooms during winter-time.

The circulation and temperature in the extremities are best maintained by warm and particularly by roomy coverings for both feet and hands. For the hands, loose gloves lined with chamois-leather are best; and for the feet, large boots or shoes, and wash-leather or woollen socks. Tight gloves and shoes, tightly-laced boots and garters, and elastic bracelets, should be particularly avoided.

As long as chilblains remain unbroken, and if the external surface is not too sensitive to pressure, various stimulating embrocations may be beneficially employed; such as Wardrop's liniment; a mixture of two parts of tincture of cantharides with six of soap-liniment; camphorated spirit; equal parts of turpentine and copaiba; or tincture of iodine and soap-liniment. When the external surface is very tender, a good local application is formed by a mixture of two ounces of collodion, six drachms of Venice turpentine, and three drachms of castor-oil; or tender chilblains, that do not itch, may be covered over by an adhesive plaster spread upon kid or chamois leather.

To relieve the itching, if it be excessive and unbearable, some resort to the expedient of rubbing the part with snow, or plunging the feet into cold water; while others find relief by putting the parts into hot water with a small quantity of mustard-flour in it.

It may happen that the daily attack of irritation occurs at some hour of the day most inconvenient to the sufferer; perhaps interfering with his enjoyment when in society, or altogether deterring him from both business and pleasure during a certain period of the afternoon or evening. In such cases much discomfort may be avoided by artificially inducing the daily attack at an earlier and more convenient hour, and this may be done by keeping the feet for a short time in mustard and warm water. Vesicated chilblains may be protected by a coating of collodion and castor-oil varnish. For ulcers or sloughs resulting from chilblains, poultices smeared with turpentine, or resin cerate, or Peruvian balsam, may be applied until the slough separates, when the sore may be dressed with any of the above-named applications upon lint.

Diseases of the Nails.

Onychia maligna is a term applied to a specific form of ulceration commencing about the matrix of the finger-nails. The disease is almost confined to children under ten years of age, and is by no means of frequent occurrence. Among more than seven thousand surgical out-patients under twelve years of age, I have found the disease in nine instances only, and these cases occurred between the ages of one year and seven.

Onychia usually has its origin in a pinch or a crush of the finger-end, such as

may either bruise the matrix or loosen the attachments of the nail. Soon after the injury, the finger-ends swell, and fluid is effused beneath the nail; which latter loses its natural colour, and becomes thin and flattened at the end, or more rarely curled up laterally. As it grows, it turns upwards from its normal attachment, and exposes beneath it an exceedingly foul and painful ulcer, having a peculiar and characteristic fœtor; while the finger-end becomes greatly enlarged and bulbous-looking, its integuments being hardened, shining, and of a livid red colour.

The disease seems little prone to spontaneous recovery; but may continue its progress until the last joint of the finger be lost, or the phalanx necrosed by extension of the ulceration.

The treatment consists, first, in the evulsion of the nail, if it be loose, displaced, or discoloured; subsequently the ulcerated surface may be dressed with black wash, or a lotion formed of one or two drachms of the liquor potassæ arsenitis to an ounce of water. The arsenical application appears to exercise some specific effect on onychia, and rarely fails. [The application of iodoform in powder, and a subsequent dressing with a saturated solution of boracic acid, will be found of great service.—R. J. G.] If these fail, a healthy action may be induced by the application of fuming nitric acid. Such constitutional remedies as seem suitable to each case may at the same time be employed; and among these chlorate of potash, with bark, appears to be of use in many cases. Amputation has been occasionally practised as a cure for this disease, and a mercurial course has been recommended. The former is an unnecessary mutilation, and the latter is not required in the form of the disease described above.

There is a form of onychia having its origin in constitutional syphilis. It usually attacks the toe-nails, and is often associated with ulcerative fissures between the toes; 'rhagades digitorum,' as they were formerly termed. In this form of the disease the ulceration is generally less extensive, the surrounding swelling is not so considerable, and the nail is less seriously implicated; while the history of the patient, or the concurrence of some other symptom of syphilis, furnishes evidence of the nature of the disease. Syphilitic onychia may be treated locally by the black or yellow wash; it being, of course, of primary importance to adopt appropriate anti-syphilitic measures.

Psoriasis may attack the nails, either those of the fingers or toes; and it is often, though not always, local evidence of constitutional syphilis. In this affection the central part of the nail becomes thickened, rough, and scabrous, and unnaturally convex; the free edge is often split; the cuticular fringe at the bottom of the nail is ragged and retracted, leaving a deep fissure between the nail and the skin of the finger. The whole nail, in an extreme case, resembles in miniature the outside of the concave shell of an oyster. The affection is chronic in its nature, and exceedingly difficult to cure. The nails are liable to some of the vegetable parasitic affections of the skin, such as that of *favus*; Dr. Hilton Fagge has recently discovered in the nails of individuals suffering from ringworm, spores, resembling those of *Tinea tonsurans*.[1]

In syphilitic psoriasis the administration of small doses of mercury continued over a long period is liable to prove beneficial; and in cases of non-syphilitic origin the most hopeful constitutional treatment is that by arsenic in combination with some tonic. The appearance of the nails may be much improved by smoothing them down with glass or fine sand-paper; or the roughness may for a time be removed by friction with dilute acetic acid; and at night-time the skin at the margins of the nails may be dressed with a mixture of white precipitate and tar-ointment.

In-grown toe-nail, as the affection is usually termed, occurs, we believe, invariably on the outer side of the nail of the great toe. It is caused either by overcrowding the toes and thereby thrusting the soft parts over the margin of the nail, or by the toe-nail being cut away too deeply at the outer angle, allowing the soft parts to encroach on the proper limits of the nail; which latter, so soon as it again grows up from

[1] *Pathological Society's Transactions*, vol. xxi. p. 407.

below, imbeds itself in the overlapping integument. The continued pressure causes considerable pain and inconvenience in walking, and if unrelieved often gives rise to a fungous growth of very sensitive granulations, which may cover the entire nail.

In the treatment of this affection it is of primary importance to secure a roomy covering for the foot. If the disease has been but a short time in progress, and has not produced any considerable mass of overhanging integument or fungous granulations, the pressure of the nail on the soft parts may be relieved by carefully packing into the cleft or groove on the affected side of the nail oiled cotton-wool in small shreds with the flat end of a probe or the edge of a penknife. This may be effected without causing any pain. The quantity of wool introduced may be gradually increased at each application, until the soft parts are raised and pushed aside, so as to expose the free edge of the nail, beneath which the wool should be inserted until the natural state of the parts is restored; when the nail should be allowed to grow up, so as to form a right angle at the outer corner. If there is much inflammation of the parts, the toe may be kept wrapped in water-dressing during the above-described treatment; while the overhanging integument may be assisted to regain its natural relation to the nail by a strip of adhesive plaster applied to it, and drawn round beneath the toe, so as to exercise some traction on the part.

Another method of relieving the flesh from pressure in more severe cases is by scraping the in-grown side of the nail very thin with glass or the edge of a knife; or the free edge of the nail may be notched, and a longitudinal division be made down to the matrix, by cutting with a knife from the surface. This will allow the partially detached strip, as it grows, gradually to overlap the body of the nail, and thus free the soft parts from pressure.

If other methods of cure fail, it is well to remove the nail by means of a central incision extending well up the back of the matrix; each half is then to be evulsed with a strong pair of forceps. It is sometimes an additional safeguard against a return of the trouble to remove the overhanging integument with the knife.

When, from neglect of remedial measures, the nail has penetrated deeply into the flesh, and there is either considerable ulceration or fungous granulations, the most successful treatment is to remove at once the offending portion of the nail. This may be done rapidly and almost painlessly, with the help of ether spray, by thrusting a strong pair of scissors beneath the nail, from its free edge down to the matrix, and tearing out the outer strip of nail with strong forceps. The same proceeding can be effected more gradually and with but little pain by those skilled in the practice, by dividing the nail with a knife from the surface towards the matrix, and then slowly separating the semi-detached portion from its deep connections.

The exuberant granulations which often form in this disease can be disposed of by dusting with the oxide of zinc, or by a lotion formed of the tincture of the sesquichloride of iron, or they may be destroyed with sulphate of copper or lunar caustic. Removal of the overhanging mass with a knife, though effectual, somewhat prolongs the healing. It has been recommended to treat this affection by the introduction of a thin strip of sheet-lead beneath the margin of the nail. The lead should be bent so as to pass round beneath the toe towards the inner side of the foot. This plan is somewhat difficult to carry out, on account of the pain it is liable to occasion.

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